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THE GIFT OF
ALICE E. ROCHFORT

AN AMERICAN TEXT-BOOK

OF THE

DISEASES OF CHILDREN.

INCLUDING

SPECIAL CHAPTERS ON ESSENTIAL SURGICAL SUBJECTS; DISEASES OF THE EYE, EAR, NOSE, AND THROAT; DISEASES OF THE SKIN; AND ON THE DIET, HYGIENE, AND GENERAL MANAGEMENT OF CHILDREN.

BY AMERICAN TEACHERS.

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PREFACE.

In the preparation of this volume the Editor's object has not been to add unnecessarily to the number of encyclopædias already existing, but to present to the profession a working text-book which shall be closely limited to, while completely covering, the field of pediatrics.

To make such a book useful to the practitioner, who must too often read as he runs, and to the student, who of necessity is unable to devote his study hours to one branch of medical science, but must divide them between many general and special subjects, it seems essential that certain conditions should be closely adhered to. These are—first, careful condensation, without omission, that the whole subject may be embraced between the covers of one readily handled volume; second, limitation of the subject-matter to such practical points as Etiology, Symptomatology, Diagnosis, and Treatment including Feeding, Hygiene, Therapeutics and the Prevention of Disease, while avoiding, so far as possible, the insertion of references to journals or authorities, of more interest to those engaged in research than to those in active practice; third, the selection of a large staff of collaborators from the most important medical centres of our country, to secure for each subject the care of the authority best fitted to portray it, to give the work broadness and stamp it with a national, rather than a sectional, imprint; fourth, so to time the publication that, without undue haste, each article contributed should have the same freshness, and the book as a whole be thoroughly abreast with the rapid advance which is constantly made in this branch of our profession; finally, the addition of chapters upon certain subjects which, though usually treated specially and separately, constantly come under the notice of those who work with, or study, the ills of childhood, such as diseases of the eye, the ear, the skin, the nose and throat, and the anus and rectum; circumcision, tracheotomy, intubation, vesical calculus, venereal disease and allied subjects. These conditions we have endeavored to fulfil.

In conclusion, the Editor desires to thank individually the collaborators he has been so very fortunate in securing, and to tender them, in advance, the greater share of whatever credit may attend the venture. His thanks are also due to Dr. Thompson S. Westcott for his most efficient and interested assistance.

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CONTENTS.

INTRODUCTION.

PAGE

THE CLINICAL INVESTIGATION OF DISEASE AND THE GENERAL MANAGEMENT OF CHILDREN. By Louis Starr, M. D. 1

Feeding.—Bathing.—Clothing.—Sleep.

THE CHEMISTRY OF MILK AND OF ARTIFICIAL FOODS FOR CHILDREN. By Albert R. Leeds, Ph. D. 37

EXERCISE AND MASSAGE. By J. Madison Taylor, A. M., M. D. 53

SEA-AIR AND SEA-BATHING IN CONVALESCENCE. By W. M. Powell, M. D. 60

PART I.

INJURIES INCIDENT TO BIRTH AND DISEASES OF THE NEW-BORN. By Edward P. Davis, A. M., M. D. 68

Caput Succedaneum.—Cephalhæmatoma.—Hæmatoma of the Sterno-cleido-mastoid Muscle.—Hæmorrhage in the New-born.—Asphyxia.—Hæmorrhages from Mucous Surfaces.—Obstetric Paralysis and Injuries to the Nervous System.—Fractures and Dislocations of the Trunk and Extremities.—Umbilical Hæmorrhage.—Umbilical Polypi.—Umbilical Hernia.—Gastro-intestinal Hæmorrhage.—Icterus Neonatorum.—The Infections attacking the New-born.—General Septic Infection.—Erysipelas.—Acute Peritonitis in the New-born.—Tubercular and Typhoid Infections.—Inspiration Pneumonia.—Tetanus.—Mastitis.—Infections of the Blood.—Melæna Neonatorum.

PART II.

THE DIATHETIC DISEASES.

TUBERCULOSIS. By Wm. Osler, M. D., M. R. C. P. 94

General Etiology and Morbid Anatomy.—Generalized Forms of Tuberculosis: 1. Acute Miliary Tuberculosis; 2. Chronic Diffuse Tuberculosis.—Localized Tuberculosis: 1. Tuberculosis of Lymph-glands; 2. Tuberculosis of Intestines, Abdominal Organs, and Peritoneum; 3. Tuberculosis of the Lungs.—Treatment.

HEREDITARY SYPHILIS. By Henry Dwight Chapin, M. D. 127

PART III.

THE ACUTE INFECTIOUS DISEASES.

PAGE
MEASLES. By Louis Starr, M. D. 141
SCARLET FEVER. By Marcus P. Hatfield, M. D. 155
RUBELLA. By Wm. T. Plant, M. D. 176
CHICKEN-POX. By Wm. T. Plant, M. D. 179
VARIOLA AND VARIOLOID. By C. G. Jennings, M. D. 183
VACCINIA. By Thompson S. Westcott, M. D. 191
PAROTITIS. By Andrew F. Currier, M. D. 197
WHOOPING-COUGH. By J. P. Crozer Griffith, M. D. 202
TYPHOID FEVER. By Chas. Warrington Earle, M. D. 214
EPIDEMIC CEREBRO-SPINAL MENINGITIS. By Roland G. Curtin, M. D. . . 230
EPIDEMIC INFLUENZA. By Chas. Warrington Earle, M. D. 236
ERYSIPELAS. By Frederick A. Packard, M. D. 243
CHOLERA. By E. O. Shakespeare, M. D. 253
DIPHTHERIA. By Dillon Brown, M. D. 272
TRACHEOTOMY. By Henry R. Wharton, M. D. 290
INTUBATION OF THE LARYNX. By Henry R. Wharton, M. D. 311

PART IV.

GENERAL DISEASES NOT INFECTIOUS.

MALARIAL FEVER. By W. S. Thayer, M. D. 319
RACHITIS By J. Lewis Smith, M. D. 335
RHEUMATISM. By J. M. DaCosta, M. D., LL.D. 367

PART V.

DISEASES OF THE BLOOD.

ANÆMIA, SPLENIC ANÆMIA, LYMPHATIC ANÆMIA, AND LEUKÆMIA.
By Frederick A. Packard, M. D. 375
HÆMOPHILIA. By Wm. Perry Northrup, M. D. 393
PURPURA HÆMORRHAGICA. By Geo. Roe Lockwood, M. D. 395
SCORBUTUS. By Wm. Perry Northrup, M. D. 405

PART VI.

DISEASES OF THE DIGESTIVE ORGANS.

PAGE

I. DISEASES OF THE MOUTH; II. DENTITION. By F. Forchheimer, M. D. 412

Stomatitis Catarrhalis.—Stomatitis Aphthosa.—Stomatitis Mycosa.—Stomatitis Ulcerosa.—Stomatitis Gangrenosa.—Stomatitis Crouposa and Diphtheritica.—Stomatitis Syphilitica.—Dentition.

DISEASES OF THE PHARYNX AND NASO-PHARYNX. By W. E. Casselberry, M. D. 431

Acute Pharyngitis and Naso-pharyngitis.—Simple Chronic Pharyngitis and Elongation of Uvula.—Chronic Folliculous Pharyngitis.—Acute Folliculous Tonsillitis.—Peritonsillar Abscess or Suppurative Tonsillitis.—Hypertrophy of the Tonsils.

GASTRIC CATARRH (ACUTE AND CHRONIC); GASTRIC ULCER. By A. D. Blackader, M. D. 457

MUCOUS DISEASE (CHRONIC GASTRO-INTESTINAL CATARRH). By W. A. Edwards, M. D. 470

DIARRHŒAL DISEASES. By Victor C. Vaughan, M. D. 479

Acute Intestinal Indigestion.—Chronic Intestinal Indigestion.—Milk Infection, Acute, Subacute.

INFLAMMATION OF COLON AND RECTUM (DYSENTERY). By S. S. Adams, M. D. 501

CHRONIC CONSTIPATION. By J. Henry Fruitnight, A. M., M. D. 512

SIMPLE ATROPHY. By Louis Starr, M. D. 519

DISEASES OF THE CÆCUM AND APPENDIX. By John Ashhurst, Jr., M. D. 525

INTUSSUSCEPTION. By John Ashhurst, Jr., M. D. 533

INTESTINAL PARASITES. By Chas. W. Townsend, M. D. 540

DISEASES OF THE LIVER. By John H. Musser, M. D. 554

Jaundice.—Congestion of the Liver.—Fatty Liver.—Amyloid Disease of the Liver.—Syphilitic Inflammation of the Liver.—Suppurative Hepatitis.—Hydatid Disease.—Cirrhosis of the Liver.

PERITONITIS, TUMORS OF THE PERITONEUM AND OMENTUM, AND ASCITES. By J. Henry Fruitnight, A. M., M. D. 579

CONGENITAL INTESTINAL MALFORMATIONS, AND DISEASES OF THE ANUS AND RECTUM. By Henry R. Wharton, M. D. 591

Pruritus Ani.—Syphilitic Affections of the Anus.—Vegetations and Warts.—Fistula in Ano.—Fissure of the Anus.—Stricture of the Anus.—Marginal Abscess.—Diphtheria of the Anus.—Proctitis and Periproctitis.—Ischio-rectal Abscess.—Ulceration, Stricture, and Syphilis of the Rectum.—Prolapsus of the Rectum.—Hæmorrhoids.—Polypus and Nævus of the Rectum.—Malignant Diseases of the Rectum.—Wounds of, and Foreign Bodies in, the Rectum.

PART VII.

DISEASES OF THE NERVOUS SYSTEM.

SIMPLE CEREBRAL MENINGITIS. By Thos. S. Latimer, M. D. 612

SIMPLE CEREBRO-SPINAL MENINGITIS. By Thos. S. Latimer, M. D. . . . 621

PAGE

TUBERCULAR MENINGITIS, AND HYDROCEPHALUS. By Landon Carter Gray, M. D. 626

ABSCESS OF THE BRAIN. By Frederick Peterson, M. D. 632

TUMORS OF THE BRAIN AND MENINGES. By Frederick Peterson, M. D. 636

THE AFFECTIONS OF THE NERVOUS SYSTEM DUE TO INHERITED SYPHILIS. By Chas. W. Burr, M. D. 647

INFANTILE CEREBRAL PALSIES. By Frederick Peterson, M. D. 651

SPEECH DEFECTS AND ANOMALIES. By Chas. K. Mills, M. D. 660

IDIOCY AND IMBECILITY. By Chas. K. Mills, M. D. 669

CRETINISM. By Chas. K. Mills, M. D. 682

MYOTONIA, OR THOMSEN'S DISEASE. By Chas. K. Mills, M. D. 687

ACROMEGALY. By Chas. K. Mills, M. D. 690

ATHETOSIS AND ATHETOID AFFECTIONS. By Chas. K. Mills, M. D. . . 694

INSANITY IN CHILDREN. By Chas. K. Mills, M. D. 697

IMPERATIVE MOVEMENTS, HEAD-NODDING, ETC. By Chas. K. Mills, M. D. 712

HEADACHE. By Chas. K. Mills, M. D. 718

HYSTERIA. By James Hendrie Lloyd, M. D. 727

CONVULSIONS. By Frederick Peterson, M. D. 741

EPILEPSY. By James Hendrie Lloyd, M. D. 747

CHOREA. By M. Allen Starr, M. D., Ph. D. 754

TETANY. By Henry M. Lyman, M. D. 764

PSEUDO-HYPERTROPHIC MUSCULAR PARALYSIS. By F. T. Miles, M. D. 768

FACIAL PARALYSIS, AND FACIAL HEMIATROPHY. By Chas. W. Burr, M. D. 774

INFLAMMATORY DISEASES OF THE SPINAL MENINGES AND SPINAL CORD. By Archibald Church, M. D. 777

ACUTE ANTERIOR POLIOMYELITIS. By Archibald Church, M. D. . . . 789

LANDRY'S PARALYSIS. By Archibald Church, M. D. 798

TUMORS OF THE SPINAL CORD. By James Hendrie Lloyd, M. D. 801

SYRINGOMYELIA AND HYDROMYELIA. By James Hendrie Lloyd, M. D. 809

HEREDITARY ATAXIA. By Archibald Church, M. D. 815

RAYNAUD'S DISEASE. By Thompson S. Westcott, M. D. 820

PART VIII.

DISEASES OF THE RESPIRATORY SYSTEM.

DISEASES OF THE NOSE. By W. E. Casselberry, M. D. 826

Acute Rhinitis.—Simple Chronic Rhinitis and Purulent Rhinitis.—Hypertrophic Rhinitis.—Atrophic Rhinitis.—Nasal Myxomata.—Hereditary Syphilis of the Nose and Throat.

PAGE
CATARRHAL LARYNGITIS (SPASMODIC CROUP). By H. Illoway, M. D. . 844
LARYNGISMUS STRIDULUS. By H. Illoway, M. D. 857
FOREIGN BODIES IN LARYNX AND TRACHEA. By John B. Deaver, M. D. 865
POST-NATAL ATELECTASIS. By S. S. Adams, M. D. 871
BRONCHO-PNEUMONIA. By William Pepper, M. D. 876
CROUPOUS PNEUMONIA. By William Pepper, M. D. 885
GANGRENE AND ABSCESS OF THE LUNG. By Henry Jackson, M. D. . . 891
BRONCHITIS. By W. S. Christopher, M. D. 896
PLEURISY AND EMPYEMA. By Henry Koplik, M. D. 907
PULMONARY EMPHYSEMA. By John Dorning, M. D. 922
BRONCHIAL ASTHMA. By John Dorning, M. D. 928
FIBROID PHTHISIS. By Frederick C. Shattuck, M. D. 935

PART IX.

DISEASES OF THE HEART.

CONGENITAL AFFECTIONS OF THE HEART. By Barton Cooke Hirst, M. D. 940
ORGANIC DISEASE OF THE HEART. By Floyd M. Crandall, M. D. . . . 946
Pericarditis.—Acute Endocarditis.—Chronic Heart Disease.
FUNCTIONAL AFFECTIONS OF THE HEART (THE CARDIAC NEUROSES). By J. C. Wilson, M. D. 958

PART X.

DISEASES OF THE GENITO-URINARY SYSTEM.

HÆMATURIA, PYURIA, ENURESIS, Etc. By E. M. Buckingham, M. D. . . 963
DIABETES MELLITUS, DIABETES INSIPIDUS, AND LITHIASIS. By James Tyson, M. D. 971
ACUTE AND CHRONIC NEPHRITIS, AND AMYLOID DISEASE OF THE KIDNEY. By I. N. Danforth, M. D. 983
TUMORS AND OTHER ENLARGEMENTS OF THE KIDNEY. By Thomas R. Neilson, M. D. 999
Renal Cysts.—Hydronephrosis.—Pyonephrosis.—Perinephritic Abscess.—Tumors of the Kidney.
VESICAL CALCULUS. By J. William White, M. D. 1010
GONORRHŒA AND VULVO-VAGINITIS. By J. William White, M. D. . . 1025
PHIMOSIS, ADHERENT PREPUCE, PARAPHIMOSIS. By Henry R. Wharton, M. D. 1029

PART XI.

PAGE

DISEASES OF THE SKIN. By W. A. Hardaway, M. D. 1034

I. Disorders of the Glands: *Sebaceous Glands:* Seborrhœa, Comedo, Acne, Milium. *Sweat-Glands*: Hyperidrosis, Miliaria.

II. Inflammations: Erythema Simplex, Erythema Multiforme, Herpes Iris, Erythema Nodosum, Relapsing Scarlatiniform Erythema, Eczema, Lichen Planus, Psoriasis, Pemphigus, Herpes Simplex, Herpes Zoster, Impetigo Contagiosa, Dermatitis Exfoliativa Neonatorum, Dermatitis Gangrenosa Infantum (Crocker), Urticaria Pigmentosa, Pityriasis Rosea, Prurigo, Furunculus.

III. Hæmorrhages: Purpura.

IV. Hypertrophies: Lentigo, Ichthyosis, Molluscum Epitheliale, Verruca, Nævus Pigmentosus, Sclerema Neonatorum, Scleroderma, Morphœa.

V. Atrophies: Albinism, Leucoderma, Alopecia Areata.

VI. New Growths: Kaposi's Disease, Nævus Vascularis, Lupus Vulgaris, Scrofuloderma, Syphiloderma.

VII. Parasitic Affections: Tinea Favosa, Tinea Trichophytina, Scabies, Pediculosis.

PART XII.

DISEASES OF THE EAR. By B. Alexander Randall, A. M., M. D. 1102

I. Affections of the External Ear: Eczematous Inflammations, Furuncle, Cerumen Impaction, Foreign Bodies, Caries of the Wall of the Auditory Canal, Congenital Atresia.

II. Affections of the Middle Ear: Acute Simple Inflammation of Middle Ear, Acute Suppurative Inflammation of Middle Ear, Chronic Suppuration of Middle Ear.

III. Affections of the Internal Ear.

PART XIII.

DISEASES OF THE EYE. By G. E. de Schweinitz, M. D. 1122

I. Diseases of the Lids: Abscess and Furuncle, Hordeolum, Exanthematous Eruptions, Blepharitis, Phthiriasis, Syphilis of the Eyelids, Tumors and Hypertrophies, Tarsitis, Blepharospasm, Ptosis, Lagophthalmos, Symblepharon, Trichiasis and Distichiasis, Entropion, Ectropion, Milium, Molluscum Contagiosum, Sebaceous and Dermoid Cysts, Injuries of the Eyelids, Emphysema of the Eyelids.

II. Diseases of the Conjunctiva: Simple Conjunctivitis, Purulent Conjunctivitis, Diphtheritic Conjunctivitis, Spring Catarrh, Follicular Conjunctivitis, Granular Conjunctivitis, Ecchymosis of Conjunctiva, Chemosis, Tumors and Cysts, Tubercle, Injuries, Phlyctenular Kerato-Conjunctivitis.

III. Diseases of the Cornea: Ulcer, Kerato-malacia, Interstitial Keratitis, Injuries, Foreign Bodies.

IV. Diseases of the Iris and Ciliary Body: Iritis, Gumma of Iris, Injuries to the Iris and Ciliary Region, Sympathetic Irritation and Sympathetic Inflammation.

V. Diseases of the Lachrymal Apparatus: Dacryoadenitis, Dacryocystitis, Lachrymal Abscess.

VI. Diseases of the Orbit: Periostitis, Cellulitis, New Growths.

VII. Congenital Cataract.

VIII. The Refraction of the Eye in Childhood.

IX. Strabismus, or Squint.

AN AMERICAN TEXT-BOOK

OF THE

DISEASES OF CHILDREN.

INTRODUCTION.

THE CLINICAL INVESTIGATION OF DISEASE AND THE GENERAL MANAGEMENT OF CHILDREN.

By LOUIS STARR, M. D.,
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I. The Clinical Investigation of Disease.

Early life may be divided into two periods—namely, infancy and childhood. Infancy is the time elapsing between birth and the complete eruption of the milk teeth, an event that transpires about the end of the second year of life; childhood extends from this age to the development of puberty, about the age of thirteen or fifteen years.

Of the diseases that may occur during these periods a few are peculiar to the time of life, or are "children's diseases" proper; others, while identical in class with the ordinary affections of adult and mature years, are variously modified in symptoms and course by conditions inherent to early age; but in all the clinical investigation is beset with difficulties which the student must be prepared to overcome. Thus, the absence of speech in the infant deprives us of the important assistance afforded by correctly described subjective symptoms, and renders it necessary to look to the mother or nurse for the history of an illness. In older children the case is little better, since with them words are not prompted by sufficient knowledge to be of great service. Further, the wilfulness, dislikes, fear, and agitation of the child are impediments which must be overcome before a satisfactory examination can be made, and which will often tax the skill and patience of the physician to the utmost in the overcoming. Another source of difficulty lies in the activity of growth and development in infants, which renders them liable to be affected by slight causes, and makes disease sudden in its attack, short in its course, and intense in its symptoms. The rapid development of the nervous system especially leads to confusion. The nerves bind every portion of the frame in a sympathy so close that an affection of a single part may cause marked general disturbance, and local symptoms are often reflected, directing attention to organs very distant from those really diseased. Finally, the extreme excitability of the nervous system of healthy children often causes a trifling illness to assume an aspect of the greatest gravity; while, on the contrary, the depression of nervous sensi-

bility that attends chronic wasting diseases so obscures the symptoms that a dangerous intercurrent affection may appear trifling or remain altogether latent.

On the other hand, to offset these difficulties, disease in the child is usually uncomplicated, rarely has its course and symptoms modified by tissue lesions the result of previous affections, and never by vicious habits, such as the abuse of stimulants and narcotics, or by mental overwork and nerve-strain. The confusing element of misstated subjective symptoms is also absent, while correct diagnosis is greatly aided by the facility with which physical examination of the whole body may be practised.

In conducting the investigation it is well to proceed in three regular stages, as follows: 1st. Questioning the attendants; 2d. Inspecting the child; 3d. Physical examination.

1. Questioning the Attendants.

When the patient is under eight or ten years of age, the only way of obtaining a knowledge of the previous history and of what may occur between visits is carefully to question the mother or nurse. The account must be patiently elicited, and credited with due reference to the narrator's intelligence. It is well never entirely to discredit a statement without good reason, for many women, though weak and foolish in other respects, are excellent observers when their powers are guided by affection. Besides, being thoroughly acquainted with their children's habits and dispositions, they will often detect deviations from health that the physician might overlook entirely. This part of the examination, particularly when the acquaintance and good-will of the child have not previously been obtained, should, if possible, be made before entering the sick-room.

As there are certain points about which it is always necessary to be informed, the adoption of a definite order of questioning is advisable.

The family history as far back as the parents should first be ascertained, inquiry being chiefly directed to the detection of chronic maladies and transmissible diseases, as tuberculosis and syphilis. If any deaths have occurred, their causation should be investigated; and an inquiry into the occurrence, or the reverse, of previous stillbirths is often important. Then an outline of the child's life from birth up to the date of the illness in question must be obtained. This should include the following items: The manner of feeding during infancy—whether at the breast or from a bottle, and if the latter, the composition of the food employed; the date of commencement and the regularity of dentition; the general state of health in regard to strength or weakness and liability to illness; the time of occurrence and the nature of any prominent attack of illness, especially of the eruptive fevers; whether vaccination has been performed or no; the hygienic surroundings—for instance, the healthfulness of the locality of residence, the sort of house and room occupied, and the character of the clothing and food. In older children, if at school, the time devoted to study, and if at labor, the nature and the hours of work.

After this it is necessary to fix the time the attack in hand began. The occurrence of some striking symptom, as convulsions or violent vomiting, often establishes this point beyond a doubt; but when there is any uncertainty the best plan is to question back, day by day, until a time is reached at which the child was perfectly well, and to date the onset from this period. The most common of the general indications of commencing illness are disturbed sleep and irritability of temper.

The next step is to learn the mode of attack and the symptoms and course of the disease prior to the first visit. The questions now must be general, never leading. They must be sufficiently exhaustive to touch upon all the functions of the body, and when a trail is started it must be patiently followed to the end. Alterations in sleep, bodily strength, surface temperature, appetite, digestion, urine elimination, respiration, and so on, must be sought for, and the account of such deviations from the normal state as vomiting, diarrhœa, or cough will suggest further questions, as well as point out the path to be followed in the future examination.

This portion of the investigation is closed by an inquiry into the treatment that may have been already adopted.

2. Inspecting the Child.

When the eye and ear of the physician are trained to their work, valuable information can be obtained by simply looking at an ill child and listening to its cry or spoken words. Even while the child is lying asleep or sitting quietly in the nurse's lap many facts may be learned; but this portion of the examination is never complete without an inspection of the naked body. The points thus ascertained consist in alterations in the expression of the face, in decubitus, in the appearances of the body, and so on, and may be designated the *features* of disease. The relative position of the observer and patient during inspection is of importance. If possible, the former should stand with his back to, and the latter be so placed that his face is toward, a window or lamp. The light must never be strong enough to dazzle when the countenance is the object of inspection, as this causes distortion of the features.

For convenience, the *features* of disease will be studied under different headings; and since to appreciate them it is necessary to have a knowledge of the healthy aspect, both the normal and abnormal appearances will be described.

Face.—The face of a healthy sleeping child wears an expression of perfect repose. The eyelids are completely closed, the lips slightly parted, and while a faint sound of regular breathing may be heard, there is no perceptible movement of the nostrils. Incomplete closure of the lids, with more or less exposure of the whites of the eyes, is noted when sleep is rendered unsound by moderate pain and during the course of all acute and chronic diseases, particularly when they assume a grave type. Twitching of the lids heralds the approach of a convulsion, and at such times, too, there is often oscillation of the eyeballs or squinting. A marked smile, due to contraction of the muscles about the mouth, signifies abdominal pain or colic, and pursing out of the lips and chewing motions of the jaw, gastro-intestinal irritation. Dilatation of the alæ nasi, with or without noisy breathing, points to embarrassed respiration, the result of extensive bronchial catarrh, pneumonia, or pleurisy with effusion.

When awake and passive the healthy infant's face has a look of wondering observation of whatever is going on about it. As age advances the expression of intelligence increases, and every one is familiar with the bright, round, happy face of perfect childhood, so indicative of careless contentment and so mobile in response to emotions.

The picture is altered by the onset of any illness, the change being in proportion to the severity of the attack. An expression of anxiety or of suffering appears, or the features become pinched and lines are seen about the eyes and mouth. Pain most of all sets its mark upon the countenance, and by noting the feature affected it is often possible to fix the seat of serious disease. Thus, contraction of the brows denotes pain in the head; sharpness of the nostrils,

pain in the chest; and a drawing of the upper lip, pain in the abdomen. As a rule, the upper third of the face is modified in expression in affections of the brain, the middle third in diseases of the chest, and the lower third in lesions of the abdominal viscera. Puffiness of the eyelids and a fulness of the bridge of the nose indicate dropsy, and should direct attention to the kidneys. When there is a tuberculous tendency the face is often oval, the features delicate, and the expression intelligent; the hair fine and silky; the skin smooth and transparent; the temporal veins visible; the eyelashes long and curving, the irides large and deep-colored, and the sclerotics pearly white or bluish; finally, a growth of fine hair is often noticeable on the temples and in front of the ears. On the contrary, the face may be round and heavy; the complexion doughy; the upper lip swollen; the nostrils wide and the alæ of the nose thick; the eyelids swollen and reddened at their edges; the hair coarse; and the lymphatic glands of the neck enlarged.

A marked disfigurement of the face may indicate one of several diseases, according to its character. For example, broadness or complete flatness of the bridge of the nose is significant of constitutional syphilis. A large, square head and projecting forehead, with a face of natural size or smaller, show that the child has suffered from rickets. An immense globular head, overhanging forehead, and diminutive face, with eyeballs projected downward and irides almost concealed by the lower lids, are pathognomonic signs of chronic hydrocephalus.

Decubitus.—The complete repose depicted on the countenance of a healthy sleeping child is shown also by the posture of the body. The head lies easy on the pillow; the trunk rests on the side, slightly inclined backward; the limbs assume various but always most graceful attitudes, and no movement is observable but the gentle rise and fall of the abdomen in respiration. In the waking state the child, after early infancy, is rarely still. The movements of the arms, at first awkward, soon become full of purpose as he reaches to handle and examine various objects about him. The legs are idle longer, though these, too, soon begin to be moved about with method, feeling the ground in preparation for creeping and walking.

With the onset of disease the scene changes. In acute attacks attended with pain sleep is no longer restful. The infant is content only when rocked, fondled, or "walked" in the nurse's arms. The older child tosses about uneasily in bed, or demands a constant change from the bed to the lap. During the waking hours the movements are purposeless, quick, and impatient, the position is constantly shifted, and frequent whining complaints are made. As a contrast to this condition of jactitation, at the beginning of the specific fevers children often lie quiet and drowsy for hours. In chronic affections attended with debility the movements become slow and languid, and in stupor and coma there are perfect stillness and immobility.

There are certain positions and gestures which have especial significance. Sleeping with the head thrown back and the mouth open is a frequent accompaniment of chronic enlargement of the tonsils. A tendency to "sleep high"—that is, with the head and shoulders elevated by the pillow—indicates impaired pulmonary or cardiac function. So, too, does an upright position in the nurse's arms, with the chest against her breast and the head hanging over her shoulder—a posture assumed by young children. "Sleeping cool"—namely, resting only after all the bed-clothing has been kicked off—is an early symptom of rickets. The position termed *en chien de fusil* is a symptom of the advanced stages of cerebral disease, especially tubercular meningitis. The child lies upon one side, with the head stretched far back, the arms pressed close to the

sides and folded across the chest, the thighs drawn up toward the abdomen, the legs flexed on the thighs, and the feet crossed. Restless movements of the head or boring of the head into the pillow also point to cerebral disease. A retained position, as on the back or one side, together with short, quick breathing, points to some inflammatory change in the respiratory or abdominal organs. Persistent lying on the face is an evidence of photophobia.

Of gestures, the frequent carrying of the hand to the head, ear, or mouth indicates headache, earache, or the pain of dentition respectively, and constant rubbing of the nose is a feature of gastro-intestinal irritation.

If the thumbs be drawn into the palms of the hands and the fingers tightly clasped over them, or if the toes be strongly flexed or extended, a convulsion may be expected. The presence of clonic contractions of the muscles, with unconsciousness, indicates, of course, a convulsion; while irregular, badly co-ordinated, jerky movements—consciousness being retained—attend chorea. In infants the existence of colic is shown by repeated extension and retraction of the legs, clenching of the hands into fists, flexion and extension of the forearms, and a writhing movement of the trunk. The fact of one limb remaining passive while the others are actively moved about naturally suggests motor paralysis.

The Skin.—In the new-born infant the color of the skin varies from a deep to a light shade of red. After the lapse of a week this redness fades away, leaving the surface yellowish-white, and in a fortnight the skin assumes its typical appearance. Allowing for natural variations in complexion, the skin of a healthy child is beautifully white, transparent, and velvety. The cheeks, palms of the hands, and soles of the feet have a delicate pink color, and the general surface is rosy in a warm atmosphere, marbled with faint blue spots or lines in a cool one. As age advances the coloring becomes more pronounced, and until the completion of childhood the complexion is much fresher than in adult life.

Lividity of the eyelids and lips is a sign of imperfect aëration of the blood and points to pulmonary or cardiac disease. Marked blueness of the whole face is a symptom of *morbus cæruleus*, and indicates a congenital malformation of the heart. On the other hand, a faint purple tint of the eyelids and around the mouth shows weak circulation merely, or, more frequently, deranged digestion. A decided yellow hue of the skin and conjunctivæ is seen in jaundice; an earthy tinge of the face in chronic intestinal diseases; a waxy pallor in renal diseases; and paleness in any affection attended with exhaustion. Brownish-yellow discoloration of the forehead is significant of inherited syphilis; a bright, circumscribed flush on one or both cheeks, of inflammation of the lungs or pleura or of gastro-intestinal catarrh, according to its occurrence with or without an elevated temperature.

In addition to the cutaneous lesions of the eruptive fevers, each having its special characteristics, an eruption of herpetic vesicles on the lips may be mentioned as present both in pneumonia and in malarial fevers.

Slight want of proper aëration of the blood is shown by blueness of the finger-nails; a greater degree, by cyanosis of the whole hand. Deformity of the nails is a symptom of syphilis; clubbing of the finger-tips, of chronic lung disease; and redness, swelling, and suppuration about the nails, of struma. The dropsy of scarlatinal nephritis causes a puffiness and cushiony appearance of the dorsum of the hands. Often, too, in this condition, the finger-ends are glossy as if smeared with oil, and there is an exfoliation of the epidermis about the nails. The last two symptoms frequently serve to confirm a retrospective diagnosis of scarlet fever.

Mode of Drinking.—By watching an infant taking the breast or bottle some knowledge can be obtained of the condition both of the mouth and throat and of the respiratory organs.

If there be any soreness of the mouth, the nipple is held only for a moment, and then dropped with a cry of pain. When the throat is affected, deglutition is performed in a gulping manner, an expression of pain passes over the face, and no more efforts are made than required to satisfy the first pangs of hunger. Under similar circumstances older children drink little and refuse solid food entirely. An infant suffering from the oppression of pneumonia or severe bronchitis seizes the nipple with avidity, swallows quickly several times, and then pauses for breath. In older patients the act of drinking, which should be continuous, is interrupted in the same way.

If the finger be put into the mouth of a healthy baby, it will be vigorously sucked for some little time. The diminution of the act of suction during a severe illness is a sign of danger; its re-establishment a good omen. In conditions of stupor and coma it is noticeably absent.

The Cry.—Crying is the chief, if not the only, means that the young infant possesses of indicating his displeasure, discomfort, or suffering. Even long after the powers of speech have been developed, the cry continues to be the main channel of complaint. It may be accepted as a rule that a healthy child rarely cries. Of course, some acute pain, as from a fall or accident or blow, will cause crying in the most healthy child, but the storm is quickly over. Incessant, unappeasable crying is due to one of two causes—namely, earache or hunger—and the distinction may readily be made by putting the child to the breast or offering a properly-prepared bottle. The *hydrencephalic* cry, denoting pain in the head, is a sudden, sharp, very loud, and paroxysmal shriek. Crying during an attack of coughing or for a brief time afterward, and attended with distortion of the features, indicates pneumonia. In acute pleuritis the cry also accompanies the cough, but it is produced too by movements of the body and by pressure on the affected side. It is louder, indicative of greater suffering, and sometimes most difficult to check. Intestinal pain causes crying just before or after an evacuation of the bowels, and is associated with wriggling movements of the body and pelvis and with eructation or the passage of flatus. Conditions of general distress or malaise predispose to fits of fretful crying, the paroxysms being excited by any disturbing influence, or even by merely looking at the little sufferer.

When the cry has a nasal tone, it indicates swelling of the mucous membrane of the nares or other obstructing condition. Thickening and indistinctness occur with pharyngeal affections. A loud, brazen cry is a precursor of spasmodic croup. Hoarseness points to a lesion of the laryngeal mucous membrane, either catarrhal or syphilitic in nature. In membranous croup and in some cases of extreme exhaustion the cry is faint and inaudible. Finally, in severe croupous pneumonia, in extensive pleural effusion, and in rickets ordinary disturbing causes are inoperative for the production of fits of crying, and there is a seeming unwillingness to cry, on account of the action interfering with the respiratory function.

The conditions of altered tone apply equally to the articulate voice in children who are old enough to speak.

The cough, too, must not be disregarded. Many of its characters correspond with the voice and cry. It is brazen in spasmodic croup, suppressed in true croup, hoarse in laryngeal catarrh, and so on. But it has certain features of its own. In bronchitis it is more or less paroxysmal, evidently dry in the early stages, loose and rattling as the catarrh "breaks up." In the

painful pulmonary affections, pneumonia and pleurisy, it is choked back, and whenever it occurs an expression of pain passes like a cloud over the face. In pertussis the peculiar spasmodic cough is the pathognomonic symptom. Cough is always unproductive—that is, unattended by expectoration—in children under seven years of age.

The formation of tears rarely begins before the third or fourth month of life. Subsequently, an alteration in this secretion may be of aid in forecasting the result of disease. The prognosis is bad when the tears become suppressed; good when the secretion continues during an illness or when it reappears after being suppressed.

There are several other sources of information which should be investigated before proceeding to the physical examination, although, strictly speaking, they do not come under the head of inspection of the child. These are the alterations in the odor of the breath, and the characters of the fæcal evacuations, of the urine, and of material ejected by vomiting.

The Breath.—The breath of a healthy child is odorless, or, as the nurse will say, "sweet," except perhaps immediately after taking nourishment, when it may, for a short time, have the smell of milk or other food. Any persistent odor is abnormal.

Any morbid condition of the system that prevents the elimination of metamorphosed nitrogenous tissue through the mucous membrane of the intestines or retards the passage of decomposing detritus along the bowels will cause an offensive breath. Under this head are conditions characterized by high temperature, catarrhal inflammation of the gastro-intestinal tract, chronic debilitating diseases, etc. The same result also frequently attends structural lesions of the kidneys. The reason for this is, that the system, in order to get rid of poisonous matter—for accumulated waste is poison—and to maintain the balance between the constant construction and destruction of tissue, must throw off elsewhere what the intestinal glands and the kidneys fail to excrete; so the lungs take on vicarious activity and the expired air becomes tainted. Purely local causes of *halitosis* also exist. These are decayed teeth, caries of the nasal and maxillary bones, ulceration of the mucous membrane of the mouth, nose, larynx, trachea, and bronchial tubes, and gangrene of the cheeks. Chronic poisoning by lead, arsenic, or mercury, though not very common in childhood, is another cause of ill-smelling breath.

To speak in general terms, the breath may become sour, catarrhal, fœtid, gangrenous, ammoniacal, and stercoraceous. Sour breath is present, in infants more especially, when there is gastric fermentation. Catarrhal breath has numerous shades of difference. In chronic catarrh of the pharynx there is a "heavy" odor, not noticeable far from the patient's face. It is always most marked during and after sleep. Should there be associated follicular tonsillitis, the breath, while still heavy, becomes extremely offensive, with a scent somewhat like that of decaying cheese, and is very penetrating. This odor, too, is worse after sleeping. At the onset of acute catarrh of the stomach the breath sometimes has a vinous odor, at others it is sweetish, and again it has the same quality as after an inhalation of ether. Later in the attack it becomes sour or has the odor of sulphuretted hydrogen. What is known as a "feverish breath" has a heavy, sweetish smell. It is met with in diseases of high temperature; thus, it is very marked and rapid in appearance in scarlatina.

Fœtor of the breath is observed in its mildest form in such affections as aphthæ and ulcerative stomatitis. It is better developed in ozæna and necrosis of the maxillary bones. Decaying teeth give much the same odor, though it is less strong and penetrating.

Noma gives rise to a gangrenous odor, and a patient so affected will fill the room in which he lies, or even a whole dwelling, with the most sickening stench. Cases of empyema, with ulceration of the lung and discharge of pus through the bronchial tubes, have an almost equally offensive breath, but here there is often a superadded flavor of garlic.

Ammoniacal breath is observed only in patients suffering with uræmic poisoning. A purely stercoraceous breath is rare, and when met with is an accompaniment of fæcal tumor or of intussusception.

The different metallic poisons give rise to no characteristic odor, and it is necessary to look to the clinical history to determine the special poison.

The Fæcal Evacuations.—The daily number of evacuations natural for a child varies greatly with its age. For the first six weeks there should be three or four stools every twenty-four hours. After this time, up to the end of the second year, two movements a day is the normal average. Subsequently, the frequency of defecation is usually the same as in adults—once per diem. During the first period the stools have the consistence of thick soup, are yellowish-white or orange-yellow in color, with sometimes a tinge of green, have a faint fæcal, slightly sour odor, and are acid in reaction. In the second they are mushy or imperfectly formed, of uniform consistence throughout, brownish-yellow in color, and have a more fæcal odor. The last two characters become more marked as additions are made to the diet. After the completion of the first dentition the motions have the same appearance as in adult life; they are *formed*, and brownish in color, with a decided fæcal odor.

Many alterations occur in disease. The frequency of the movements may be increased, constituting diarrhœa, or lessened, constituting constipation. In the former condition the consistency is diminished, in the latter increased. Instead of being uniform throughout, the stool may be mixed, partly liquid, partly solid, indicating imperfect digestion, and curds of milk and pieces of undigested solid food may be mingled with the mass. Flaky, yellowish, or yellowish-green evacuations, containing whitish, cheesy lumps, are also met in cases of indigestion. Scanty, scybalous stools, dark-brown or black in color, and mixed with mucus, are characteristic of intestinal catarrh. Doughy, grayish, or clay-colored motions show a deficiency of bile. An intermixture of blood, altered blood-clots, and shreds of mucous membrane indicate some breach of continuity in the intestinal lining, such as occurs in follicular enteritis, typhoid fever, dysentery, and tubercular disease. Watery, almost odorless stools occur in the latter stages of entero-colitis, most offensive, carrion-like motions in both catarrhal and tuberculous ulceration of the intestines, and sour-smelling evacuations in the diarrhœa of sucklings. The discovery of worms or their ova in the stools is the certain evidence of the existence of intestinal parasites.

This outline of the changes that may take place will serve to show how much may be learned from the stools, and the importance of making a personal examination of them.

The Urine.—It is impossible to make a definite statement as to the number of times the urine is voided by a healthy infant in each twenty-four hours. In any given case the frequency will differ very much from day to day, depending upon the temperature of the surrounding air, the amount of moisture that it contains, and so on. Sometimes it will be necessary to change the diaper every hour during the day and three or four times at night. Again, it may remain dry for six, eight, or even ten hours. Neither condition indicates disease, and between the two extremes there is a wide range of variation. Should the urine not be passed for twelve hours or more, a careful examination should

be made to discover and remedy retention. As the child grows older the frequency diminishes, and at the age of three years the number of voidings will be reduced to six or eight during the waking hours, and perhaps one at night. When the desire does arise during sleep, the child, if in a normal state, wakes up and demands the chamber, and never passes urine unconsciously. Wetting the bed, therefore, or the involuntary passage of the urine during sleep, is indicative of an abnormal condition and requires investigation. Painful micturition points to inflammation of the urethra, a narrow preputial orifice, a highly acid condition of the excretion, or stone in the bladder.

The urine of a healthy infant, while it wets, should not *stain* the diaper, the fluid being clear and almost colorless. It has a low specific gravity—1.003 to 1.005—and an acid reaction. As age advances the adult characters are more and more nearly approached, though during the whole of childhood the urine is paler and of lower specific gravity than in adult life. The normal daily amount excreted cannot be stated absolutely, but the following figures are approximate: Between two and five years, 15–25 oz.; five and nine years, 25–35 oz.; nine and fourteen years, 35–40 oz. Other characters of the urine in childhood will be considered under appropriate headings in subsequent sections.

Vomiting.—Both vomiting and regurgitation are of ready production and frequent occurrence in infancy, on account of the vertical position and cylindrical outline of the stomach at this period of life. Babies suckled at an abundant breast, and who are in perfect health, often vomit habitually. In these cases, the supply of food being large, the infant as it lies at the breast is apt to draw more than it can digest. The stomach rids itself of this over-supply by an act which more nearly resembles regurgitation than vomiting, and which must be regarded as an evidence of health rather than the reverse. There is no violent effort or retching; the material ejected is the breast-milk alone, either entirely unaltered or slightly curdled; and there are no symptoms of nausea, such as paleness, languor, and faintness. In older children vomiting may also occur after the stomach has been overladen. If the act be followed by relief from the general distress, headache, and epigastric pain, it must not be regarded as a symptom of disease.

Vomiting attended with the train of symptoms embraced under the term *nausea* is not a pathognomonic symptom. It may indicate disease of the stomach, of the intestines, of the lungs and pleura, and of the brain, or it may be a prodrome of one of the eruptive fevers. Which condition is present can only be determined by watching the case. The character of the ejecta is more definite. For instance, the expulsion of mucus is a symptom of gastric catarrh. The regurgitation of mouthfuls of curdled milk, partially digested food, and liquid so sour that it causes a grimace to pass over the face, is an indication of dyspepsia, with fermentation and the formation of acid. The appearance of lumbricoid worms in the vomit—a not infrequent occurrence—of course shows conclusively the existence of these parasites in the alimentary canal.

3. Physical Examination.

The methods of physical exploration in children are identical with those employed in adults, and the results do not differ in kind. Since, however, the object of exploration is to elicit the greatest amount of information with the least possible disturbance of the child, and as this very disturbance alters the character of some of the information obtained, it is well to adopt a somewhat different order of examination, and one which at first sight may seem irregular.

Thus it is best first to ascertain the character of the respiration and the pulse, then to strip the body to determine the degree of muscular development and the condition of the skin, next to investigate the physical condition of the lungs, heart, and abdominal organs, and last of all to examine the mouth and throat. In this order, then, the normal, as well as the more prominent abnormal, features connected with the different organs will be considered.

The Respiration.—In children the respiration is chiefly *abdominal* in type, irrespective of sex, and it is not until just before the age of puberty that the movements in the female change, becoming *superior costal.* Consequently, in estimating the number of movements per minute, it is best to place the fingers lightly on the epigastrium. The count should always be made by the watch, and the most convenient time for the observation is while the child sleeps.

Soon after birth the number of movements per minute is 44, between the ages of two months and two years, 35, and between two and twelve years, 23. During sleep the frequency is reduced about 20 per cent.

Children under two years, while awake, breathe unevenly and irregularly. In sleep there is greater regularity. After the second year the movements become steady and even. All children, however, but particularly the very young, are subject to a great increase in the rapidity of respiration under excitement, either muscular or mental.

Accelerated breathing may be caused by an elevation in the body temperature, by an interference with the blood aëration, and by thoracic or abdominal pain. As the increase in frequency may be unattended by any apparent effort or true dyspnœa, it is well to make a rule of counting the respirations in every case in which the diagnosis is doubtful.

Diminished frequency is noted in certain brain affections, as in chronic hydrocephalus, and in the later stages of tubercular meningitis. In such cases the rhythm may be greatly altered—a *tidal* form being assumed; this is termed "Cheyne-Stokes respiration." Another form of breathing, in which the alteration is mainly in the rhythm, is termed *expiratory* respiration. It is characterized by the pause coming between inspiration and expiration, instead of between expiration and inspiration, as is the normal rule. This alteration occurs most frequently in young children, and is an evidence of dangerous pulmonary embarrassment.

Perfectly healthy children breathe through the nose, and so softly that it is difficult to hear the breezy sound of the ingoing and outgoing air. A dry, hissing sound or a moist sound of snuffling indicates partial obstruction of the nasal passages; oral respiration, complete occlusion. Difficult breathing with prolonged inspiration—*inspiratory dyspnœa*—shows an impediment to the entrance of air into the lungs and indicates laryngeal obstruction, due, most commonly, to spasm or to the formation of false membrane. In such cases the inspiratory act is also attended by a loud, piping, or rasping sound. Labored breathing with prolonged wheezing respiration—*expiratory dyspnœa*—occurs when the escape of air is impeded. The causative lesion is to be found, not in the larynx, but in the lungs. It may be a bronchial catarrh with excessive secretion, emphysema, or asthma. In both forms of dyspnœa the movements are slow as well as difficult, and a combination of the two forms is met with in cases of marked laryngeal stenosis.

Yawning, if it recur frequently, denotes great failure of the vital powers.

The Pulse.—To obtain any reliable data from the pulse it must be felt while the patient is perfectly quiet. The best time is during sleep, but if the child cannot be caught in this condition, advantage may be taken of its placidity while nursing at the breast, feeding from a bottle, or amused by a toy.

With very young infants it is sometimes impossible to feel the beat of the radial artery, and it is necessary to ascertain the frequency of the pulse by directly auscultating the heart. After the second month palpation of the pulse at the wrist in the ordinary way presents no difficulties.

The child's pulse differs from the adult's by being much more frequent, more irregular, and more irritable, and necessarily of smaller volume.

The frequency, or the number of beats per minute, varies with the age. The following is the average rate:

From birth to the second month	160 to 130
From the 2d to the 6th month	130 to 120
" 6th " 12th "	120 to 110
" 1st " 3d year	110 to 100
" 3d " 5th "	100 to 90
" 5th " 10th "	90 to 80
" 10th " 12th "	80 to 70

These figures represent the pulse in a waking but passive state. During sleep the frequency is less. Thus, between the second and ninth years there are about sixteen beats less per minute while asleep than when awake; between the ninth and twelfth years, eight less; and between the twelfth and fifteenth years, only two less. Below the age of two years the disparity is even greater. The irregularity of the pulse in childhood is confined to an alteration of the rhythm. It is most marked in infants, and is greatest during sleep, when the pulse is slowest. The feature of irritability—that is, the facility with which its frequency is increased by muscular activity and mental excitement—is greater in proportion to the youth of the child. A rise of 20, 30, or even 40 beats a minute is not uncommon in early infancy under the excitement of the slightest effort or disturbance. On account of these wide variations in health little symptomatic meaning need be attached to alterations of the rhythm and frequency while unassociated with other abnormal features. When so associated they become important in diagnosis.

Increased frequency is a constant attendant of the febrile state. The extent of the increase corresponds with the degree of elevation of the temperature, though the pulse curve always runs higher than the temperature curve. The more frequent the pulse the higher the fever is the rule, but in estimating the prognostic value of the increase the law of the fever in question must be taken into consideration. For example, in scarlatina a pulse of 160 is usual and not indicative of special gravity, whereas in measles the same degree of acceleration would be abnormal and show great danger. Jaundice and parenchymatous nephritis are accompanied by a diminution in the rate. Irregularity is met with in diseases of the brain and heart, and sometimes in nervous and anæmic children.

The TEMPERATURE must be estimated before removing the clothing, and a clinical thermometer must always be used. The instrument is usually placed in the rectum or groin[1] of the infant and young child; in the axilla of one old enough to understand the importance of keeping the arm in a proper attitude. It should remain in position at least five minutes.

During the first week of life the temperature fluctuates considerably. After that the puerile norm—98.5° to 99° F.—is established, but until the fourth or fifth month it is greatly influenced by healthy causes of variation, the fluctuations ranging between 0.9° and 3.6°. By the fifth month regular morning and evening oscillations begin and certain definite laws are followed. There is a

[1] The rectal temperature is normally 1° higher than the axillary; that of the groin about 1° lower.

fall in the evening of 1° or 2°. The greatest fall occurs between 7 and 9 P. M., and the minimum is reached at or before 2 A. M. After 2 A. M. there is a gradual rise, the maximum being reached between 8 and 10 A. M. Throughout the day the oscillation is trifling. These variations are independent of eating and sleeping.

In disease there may be either a rise above or a fall below the normal standard. Fever is always associated with an elevation of the temperature. Rapid and transient rises attend slight catarrhs and passing indigestions; prolonged rises, inflammatory and essential fevers. The *degree* of elevation marks the type of the pyrexia. This is moderate when the mercury stands at 102°, severe at 104° or 105°, and very grave above 107°. The *duration* of the elevation and the peculiar *range* of the oscillations—for there are oscillations in disease as well as in health—determine the nature of the fever. The febrile oscillations differ from the healthy in that the lowest marking is noticed in the morning, the highest in the evening. *Variations* in the typical range of any given fever are important prognostic omens: a sudden fall of temperature, together with improvement in the general symptoms, indicates the beginning of convalescence; a similar fall, with an increase of the general symptoms, is a precursor of death. When the morning temperature is equal to that of the preceding evening, there is great danger; if higher, greater danger still. Marked remission in continued fevers is generally a forerunner of convalescence.

Abnormal depression of temperature is occasioned by hæmorrhage and by the loss of fluids in profuse watery diarrhœa. It is also met with in anæmia, in atrophy from insufficient nourishment, in diseases of the heart and lungs attended by imperfect blood-aëration, and it constantly attends collapse and the death agony. A maintained temperature of 97° F. is dangerous in children, and for every degree of reduction below this point the risk to life is more than proportionately increased.

The General Development.—The healthy child under two years of age is plump of body and round of limb, with well-developed fat cushions and firm flesh, and with the head and abdomen large in proportion to the rest of the frame. As age advances the figure gradually assumes the characteristics of adolescence.

To be robust, the newly-born child must have a certain average size and weight. Subsequently, under normal circumstances, there is a regular rate of increase in both of these respects. At birth the length is about 19 inches. Growth is quickest in the first weeks of life. In the first year there is an increase of from 5 to $6\frac{1}{2}$ inches; in the second, from $2\frac{2}{3}$ to $3\frac{1}{3}$ inches; in the third, from $2\frac{1}{3}$ to $2\frac{2}{3}$ inches; in the fourth, about 2 inches; and from the fifth to the sixteenth year the annual growth amounts to from $1\frac{2}{3}$ to 2 inches. The average weight at birth is from 6 to 8 pounds. The daily increase in weight should range from $\frac{1}{4}$ to $\frac{3}{4}$ of an ounce. With these data it is quite possible to estimate what should be the normal size and weight of a child at any age. Consequently, if, on being measured and weighed, he be found to fall short of the normal standard, it is proper to infer the existence of some fault in the nutritive processes—a conclusion still further borne out by a want of rotundity of outline and by flabbiness of the muscles.

The age at which the child sits erect, at which it walks, and at which the anterior fontanelle becomes ossified are points closely connected with the subject of development and nutrition. For some time after birth the child, if noticed while sitting upon the lap, will be observed to hold the head and shoulders forward or to "stoop" a little, the spine from the cervical region

to the sacrum forming a continuous curve, with the convexity directed backward. Toward the end of the eighth month the position begins to become more erect, and in a few weeks is perfectly so, the spine assuming an almost perpendicular line. Any marked delay in this change indicates general debility. At the end of the fourteenth month the child should be able to walk alone. The spine then assumes the S-like curve seen in healthy adults. A delay in walking may be due to systemic weakness or infantile paralysis affecting one or both legs. If the walking be done on the toes chiefly, if the gait be limping, and especially if knee-pain be complained of and manipulation of the limbs causes suffering, the chances are that hip-joint disease is commencing. The anterior fontanelle should be ossified or completely closed at some period between the fifteenth and twentieth months. The closure is much retarded in rickets, which is pre-eminently a disease of malnutrition. Hydrocephalus has a like effect. In a state of health the opening, while still membranous, is level with the cranial bones or very slightly depressed. Conditions of systemic exhaustion cause marked sinking, and this depression is one of the best indications of the necessity of stimulation. Bulging of the fontanelle is a symptom of chronic hydrocephalus.

Conditions of the Skin.—In addition to the characters already described, the skin of a healthy child has a velvety smoothness and softness, a scarcely perceptible moisture, and a great degree of elasticity.

"Mucous disease" is attended with a dry, harsh skin, which is muddy in color, and covered, especially on the extensor surfaces of the arms and legs, by a more or less thick layer of exfoliating epidermis. Chronic abdominal affections, particularly tuberculosis of the intestines and mesenteric glands, lead to harshness, acridity, scurfiness, and a wrinkled appearance of the skin covering the abdomen and thorax, with enlargement of the superficial abdominal veins. Protracted diarrhœa, and, still more, vomiting combined with diarrhœa, cause absorption of the subcutaneous fat and wasting of the muscles. The skin becomes too large for the body, is dry, harsh, discolored, and so inelastic that it falls into wrinkles over the joints when the limbs are moved, and if pinched up retains the fold for a long time. The condition of general atrophy popularly known as "marasmus" presents these features most strikingly. Dryness is a concomitant of the febrile state; excessive moisture, of prostration and collapse. Eruptions appear upon the integument in the skin diseases proper, in the exanthemata, in constitutional syphilis, and in certain digestive disorders. Œdema of the subcutaneous connective tissue may be due to affections of the heart, liver, or kidneys. The cardiac variety usually shows itself first in the feet; the renal, in the eyelids; the hepatic, in the feet and legs, secondarily to ascites.

While examining the surface it is well to look for enlargement of the superficial lymphatic glands and swelling of the joints. The former occurs in tuberculosis and syphilis; the latter, in rheumatism.

Examination of the Abdomen.—To examine this portion of the body, the child, still stripped, must be placed on its back and kept as quiet as possible. Palpation or percussion should never be made with cold hands.

The abdomen of a healthy child is prominent, uniformly soft, yielding, and painless to the touch, and to percussion gives a tympanitic sound, varying in tone according to the region percussed. The tympanitic note is lowest in pitch over the epigastric and left hypochondriac regions, the seat of the stomach; highest over the umbilical region, the position of the small intestine.

In disease *inspection* reveals any disproportion in the size or form of the abdomen, the state of the integuments, of the superficial veins, and of the

umbilicus. *Palpation* shows the temperature, pliability, moisture, and tension of the walls, and the presence or absence of tenderness, of fluctuation, and of enlargement of the mesenteric glands and other solid viscera. *Percussion* serves to demonstrate the nature of enlargements, whether due to accumulation of gas or liquid or to solid growths. By it, also, the outline and size of the liver and spleen may be determined.

Distention of the abdomen is, in the vast majority of instances, due to flatulence. In this condition the skin feels tense, the umbilicus is level or slightly prominent, there is no tenderness on pressure, and percussion is markedly tympanitic. Drum-like distention, with great tenderness, and muffled tympanitic percussion-note occur in general peritonitis. Uniform distention, again, may be due to ascites. The abdomen is barrel-shaped, painless to the touch, and there is extended fluctuation. Percussion is dull over the position of the fluid, but in nearly every instance there is an area of tympany which *changes* its position. Localized distention may be traced to gaseous accumulation, to enlargement of the liver and spleen, to fæcal accumulation, to circumscribed peritonitis, and to distention of the bladder. Collections of gas are always tympanitic on percussion. The extent of liver dulness is to be estimated by percussion, or palpation with the *warmed* hand. An enlarged spleen may be felt by placing the fingers of the right hand on the back, directly below the twelfth rib and outside of the lumbar muscles, the fingers of the left on the abdomen, directly opposite, then bringing the hands toward one another. The fact that both the liver and spleen, though still unenlarged, may be more readily felt than natural when pressed downward by the diaphragm, must not be overlooked. A fæcal accumulation is distinguished by the absence of tenderness, by the oblong shape of the tumor, by the situation in the region of the transverse or descending colon, to which its long axis corresponds, and by its shape being capable of some modification by pressure. Percussion over such a mass is dull. Distention of the bladder gives rise to a bulging tumor in the hypogastric region, which is elastic to the touch and dull on percussion.

A shrunken or scaphoid condition of the abdomen is met with in serious brain affections, notably tubercular meningitis, also in entero-colitis, follicular enteritis, and dysentery.

Tenderness to pressure indicates inflammatory lesion of the intestines. The presence or absence of this sign in an infant can be determined by forcing the attention, by bringing it before a strong light, for instance, and then making pressure on the abdomen. If crying be produced, there is tenderness; if not, the reverse.

Examination of the Chest.—The stethoscope and pleximeter are unnecessary in examining the lungs. In the case of the heart the former may be occasionally required to localize murmurs. When used, it is better to give the instrument to the child to handle and become familiar with before application. The thoracic end must never be adjusted without being warmed. The quieter the patient, the more complete and satisfactory will be the results of the exploration. Unfortunately, though, it is too often necessary for one to do the best possible in the midst of cries and struggling. However, by skilfully seizing opportune moments much reliable information may be gained.

The steps of the examination are—first, inspection; second, auscultation; third, palpation; and fourth, percussion. The reason for making the order different from that practised in adults is to place the most disturbing element last. Mensuration and succussion are infrequently resorted to in children. If required, they are best postponed until the end of the examination.

Inspection.—The sitting posture, the child being stripped and in a good light, is the best for this process. Note is to be taken of the shape of the chest, the character of the breathing, and the position of the apex-beat of the heart.

In the new-born baby the chest is nearly circular in shape; later, the lateral diameter considerably exceeds the antero-posterior. The intercostal spaces are poorly marked, and the scapulæ lie so close that their outline is scarcely perceptible. The circular shape of the chest allows of little lateral expansion, and for this reason the respiration is chiefly abdominal in type. Together with the movement of the abdominal walls, every act of inspiration is attended by a certain amount of recession of the lower part of the chest-walls, the yielding ribs being forced inward by the pressure of the external air before they can be sufficiently supported by the expanding lung. The rise and fall of the cardiac apex can be seen—except when there is a great accumulation of fat—a short distance below and to the right of the left nipple.

Disease may alter all of these conditions. The tuberculous diathesis is characterized by a small chest, and one which has either the *alar* or the *flat* shape. In rickets the thorax becomes irregularly triangular in outline. Emphysema causes a barrel-shaped chest, with stooping shoulders and round back. Pleuritis with large effusion produces bulging of the affected side, and sometimes prominence of the intercostal spaces. After absorption has taken place there may be marked retraction, sinking of the interspaces, falling of the shoulders, and curvature of the spine toward the healthy side. Cessation of the costal respiratory movements indicates inflammation of the lung or pleura or a large pleuritic effusion; cessation of the abdominal play, inflammation of the peritoneum or of the intestines: excessive ascites and gaseous accumulations produce the same effect. Rachitic softening of the ribs, and those diseases of the lungs which offer a direct obstacle to the entrance of air, are associated with a great increase in the normal recession of the lower portion of the chest on inspiration. The position of the apex-beat is altered by cardiac diseases, by pleuritis, and occasionally by gaseous distention of the stomach. When the left ventricle is enlarged, it is shifted downward and to the left. Transmitted epigastric pulsation shows enlargement of the right ventricle. An extended impulse is not necessarily a sign of disease, since the chest-walls are so elastic in childhood that the normal impact of the apex is apt to affect a wide area. The effusion of pleurisy pushes the heart to the right or left, while the retraction, after absorption or evacuation, draws it in one or other direction. The apex is pushed upward and to the left in gastric flatulence. Emphysema, by pushing the heart away from the thoracic wall, diminishes or hides the impulse.

Auscultation.—With infants the back of the chest is most conveniently ausculted when the child is held in the nurse's left arm, with his breast against hers, his chin resting upon her left shoulder, his left arm around her neck, and his head kept in position by her disengaged hand; the front, when reclining on the back on a pillow; the sides, when sitting upright on the lap, first one arm and then the other being lifted up to allow the observer's ear to be applied. Older children may be made to take the same position as adults. It is not sufficient to auscult the posterior aspect of the thorax alone, as is stated by some authors. The whole chest should be examined, particularly in doubtful cases. The signs of croupous pneumonia are most frequently discoverable at one or other base, posteriorly; the friction-sound of pleuritis at the junction of the middle and lower third of the chest, laterally; and the signs of emphysema at

the apices, anteriorly. Therefore, unless the exploration be thorough, important lesions may be overlooked.

In healthy infants the inspiratory act in ordinary breathing is superficial, and the respiratory murmur, as a consequence, feeble. If, however, a deep inspiration be taken, a frequent occurrence under excitement and during crying, the murmur becomes loud, or *puerile*. After the age of two years puerile respiration is habitual. The breathing is loudest over the anterior, lateral, and posterior inferior regions of the thorax; faintest over the scapulæ and the præcordial area. Sometimes the expiratory element is wanting in young children over the lower posterior portions of the lungs. In the interscapular region there is often an approach to the bronchial type of breathing. If the child speaks, cries, or coughs while the ear is applied to the chest, a muffled rumbling sound, the normal vocal resonance, will be heard. At the same time vibration of the walls, the vocal fremitus, can be felt.

The cardiac sounds are readily heard when the ear is placed on the præcordia. In young infants the examination is somewhat difficult, but after the first year, the circulation becoming slower and more regular, there is little trouble in distinguishing the sounds, and even slight alterations in them. The first sound is longer and graver than the second, the rhythm is ordinarily quite regular, and the area of distribution is extended.

Palpation.—In practising palpation the palmar surface of the well-warmed hand must be applied to the naked chest. This method of exploration is useful as a means of determining the number of respiratory movements, the degree of expansion of the thoracic walls, the position of the cardiac apex-beat, the presence or absence of painful regions and of pleural or bronchial fremitus, the existence of fluctuation in the intercostal spaces, and the character of vocal fremitus.

Percussion.—In percussing the different surfaces of the chest the child must be placed in the same position as for auscultation. When contrasting the two sides, percussion should be made in identical regions and during the same period of the respiratory movement. Babies when constrained or when disturbed hold their breath in the intervals of crying, and as they always do so at the end of an inspiration, this is a favorable time to seize for the comparative examination. The percussion strokes must be lighter than in the adult, but in other respects the operation in no wise differs.

In health the resonance will be found to correspond closely with the respiratory murmur. Thus in infants under one year, the respiratory murmur being feeble, percussion is rather insonorous, but so soon as puerile respiration becomes established the resonance is uniformly intense. With the exception of this greater intensity the sound is exactly similar to that obtainable in adults. It is always attended, too, by a sensation of elasticity, appreciated by the finger used as the pleximeter.

Different portions of the thorax possess, normally, different degrees of sonorousness. In front, the right side is markedly resonant from the clavicle down to the fifth interspace or the upper border of the sixth rib in the mammary line, where the liver dulness begins. On the left side the resonance is equally intense, but it is encroached upon by the gastric tympany, which extends upward as high as the seventh or sixth rib, as well as by the area of cardiac dulness. The latter is never so decidedly marked as in adults. Laterally, both axillary regions are very resonant. The upper portions of the infra-axillary regions are a degree less resonant, and the lower portions are dull on account of the presence of the liver on the right and the spleen on the left side. The superior border of the liver dulness is found in the seventh interspace, or

at the eighth rib; that of the spleen, at the upper edge of the ninth rib. Gastric tympany may supplant the pulmonary resonance over the left infra-axillary region. Posteriorly, there is little resonance in the scapular region, particularly the supraspinous portions. Over the interscapular space the sound improves, but it is less resonant than anteriorly or laterally. Over the infra-scapular regions the resonance is but little less pure than in front, until the tenth rib is reached on the right side and the liver dulness is again met with. On the left side the resonance extends to the very base, the posterior splenic dulness being detected with difficulty. The right base is, therefore, naturally less resonant than the left, and this difference is especially marked during expiration, the liver rising higher at that time.

Affections of the lungs produce various alterations in the percussion sound. The chief of these are the substitution of tympany, of dulness, and of flatness for the normal resonance, and of increased resistance to the finger for elasticity. Cardiac diseases cause changes in both the extent and the shape of the area of præcordial dulness.

Examination of the Mouth and Fauces.—This portion of the examination is most apt to cause crying, but it must never be omitted. In infants gentle pressure of the fingers upon the chin is sufficient to cause wide opening of the mouth. An older child will frequently open the mouth when requested, but if he refuse, some smooth, flat instrument may be inserted in the mouth, and downward pressure made upon the tongue, when the jaws will be widely separated. The fauces can sometimes be seen by directing the mouth to be opened wide and the tongue to be alternately protruded and retracted, or a prolonged sound of "*Ah*" to be made. With the refractory, and always with infants, the tongue has to be held down by a spoon-handle or tongue-depressor.

The healthy oral mucous membrane has a deep pink color and is smooth, moist, and warm to the touch. The color is deeper on the lips and cheeks, lighter on the gums. The latter, up to the sixth month, as a rule, have a moderately sharp edge. Subsequently, the edge begins to broaden and soften, and the color of the investing mucous membrane deepens to a vivid red, and becomes hot as the teeth begin to force their way through. The first, or *milk teeth*—so called from their color—are twenty in number, all told, ten to each jaw; the two lower central incisors, the first of the set, make their appearance at some time between the fourth and seventh months, the others following at stated intervals.[1] The permanent teeth, thirty-two in number, begin to appear about the sixth year.

The tongue should be freely movable. It is pink in color, and the dorsum, or upper surface, marked in the centre by a slight longitudinal depression, has a velvety appearance, and is soft, moist, and warm to the finger. The hard palate is roughened anteriorly by transverse ridges. The soft palate is smooth, and its mucous membane is paler than that of the rest of the mouth. The fauces, on the contrary, are redder. In the triangular recess between the half-arches of the palate the tonsils can always be seen. They should be about the size and shape of almond-kernels, and they present a number of circular openings, the orifices of pouches into which the follicles open. The uvula is short and tongue-shaped. The posterior wall of the pharynx should be red, smooth, and moist.

Disease produces a great variety of changes in the mouth, tongue, and fauces. Fever makes the mouth hot and dry and causes the tongue to be frosted or coated. Affections of the gastro-intestinal tract are always attended by coating of the tongue, and the various appearances of this coating are of

[1] See article on *Dentition*.

important diagnostic and therapeutic significance. Inflammation of the mouth itself reddens the mucous membrane, makes it hot and tender to the touch, increases its moisture, alters the surface of the tongue, and leads to the formation of aphthæ, to ulceration, and even to gangrene. The eruptions of scarlet fever, measles, varicella, and varioloid make their appearance first on the mucous membrane of the palate and fauces. Finally, the conclusive evidences of diphtheria and of the various tonsillar affections are found in the fauces.

Irregular dentition indicates faulty nutrition; delayed dentition, rickets; and certain peculiarities in the formation of the permanent teeth, constitutional syphilis.

II. The General Management of Children.

1. Feeding.

The whole question of feeding bears so close a relation to age that it is necessary to study it from the standpoint of the two stages of a child's life already mentioned.

An infant may be fed in one of three ways: 1st, from the mother's breast; 2d, from the breast of a wet-nurse; and 3d, from a bottle by the method known as artificial or hand-feeding.

1st. *Feeding from the Maternal Breast.*—This, being the natural, is the proper method of nourishing the human infant; and every mother who is able should nourish her child solely from her breast up to the age of eight months, and partially to the end of the first year, or, failing in either limit, so long as possible.

The infant should be put to the breast as soon as the mother has recovered somewhat from the fatigue of labor—some four or eight hours after birth. Of course no milk can be drawn at this early date, but the babe gets a small quantity of colostrum, which affords sufficient nourishment, and from its laxative properties clears out the infant's intestinal canal. This, too, is of great advantage to the mother, for it ensures proper uterine contraction, draws out the nipples, and encourages the formation of milk. Put the child to the breast every two hours while the mother is awake, and up to the fourth day there need be no fear of starvation. Usually on the fourth day milk is secreted and regular lactation commences. Before this time the administration of gruel or any form of artificial food is more than useless, as it lessens the activity of sucking and frequently deranges the stomach.

Many untrained mothers make a failure of nursing because they know nothing of the manner of giving suck; of the length of time the child should be kept at the breast; of the proper time for, and interval between, feedings; and of the importance of regularity.

While nursing the infant must be held partly on its side, on the right or left arm according to the gland about to be drawn, while the mother must bend her body forward, so that the nipple may fall easily into the child's mouth, and steady the breast and regulate the flow of milk with the first and second finger of the disengaged hand placed above and below the nipple. Each of the breasts should be drawn alternately, and a healthy child may be allowed to nurse until satisfied. Usually during the first six weeks the breast is required every second hour from 5 A. M. until 11 P. M., and in some cases once during the night; but this night-nursing should be given up as soon as possible, that the mother may secure essential repose. Regularity in meal hours is most important, and a little perseverance will form the habit of waking to suck the breast with almost the precision of the clock. This rule,

however, is not rigid, some infants requiring food less, others more, frequently. These exceptions can only be determined by observation of individual characteristics, and every mother must early learn to distinguish the cry of hunger from that due to the pain of indigestion, and avoid the dangerous practice of resorting to constant feeding as a means of pacifying crying.

After the sixth week the interval between nursings may be slowly increased until, by the fourth month, it reaches three hours. During this period, also, the time of lying at the breast may be gradually lengthened, for the quantity of milk secreted and the child's appetite and capacity for food are all augmented as the days pass by. At the end of the sixth month feeding every fourth hour suits some children well, but as a rule the three-hour interval must be adhered to from the fourth month to the end of lactation.

After the sixth or eighth month "mixed feeding"—breast- and bottle-feeding alternating—is advisable if the babe ceases to thrive on the breast alone. Otherwise, the maxim of not interfering with any course that is doing well is as applicable here as elsewhere, and the breast may be relied upon entirely until the time comes for weaning. Should additional nutriment be required, the food must be selected with due reference to age and prepared in the same manner as in regular hand-feeding.

The date of weaning cannot be fixed for all cases, since it depends upon the health of the mother and the development of the child. When the former continues to be robust and the child steadily grows and gains flesh, lactation can be prolonged until the tenth or twelfth month. If persevered in longer, the mother's strength usually begins to fail, her milk is lessened in quantity or becomes poor in quality, the child's nutrition suffers, and it grows pale, thin, and flabby, and may develop the disease known as rickets.

Weaning may be accomplished gradually or suddenly. In gradual weaning about four weeks are required to prepare for the absolute withdrawal of the breast. For instance, if suck be given every three hours from 5 A. M. until 11 P. M., or seven times a day, there should be, during the first week of preparation, one artificial feeding and six nursings daily; during the second, two and five, and so on until the breast is entirely withheld. Carefully prepared milk food, administered from a bottle, is the best substitute. At the age of ten months a mixture that ordinarily agrees well is—

Cream	f℥ss.
Milk	f℥iv.
Sugar of milk	℥j.
Water	f℥iss.

Should fever or disordered digestion occur during the period of preparation, the number of artificial feedings must be reduced or the breast resumed until the disturbance be passed; then the course may be begun again and carried to its completion.

Sudden weaning is more difficult to accomplish, and is not advisable unless, while the breast is being presented, there is an absolute refusal to take artificial food, or unless the mother's health becomes so affected as to render any further sucking a positive peril to the child's life: attacks of erysipelas or of small-pox are instances in point.

The physician is often forced to decide upon the advisability of premature weaning. His decision must be made cautiously and after thorough investigation of two propositions—namely (*a*) the effect of further lactation upon the health of the mother; and (*b*) the requirements of the child.

(*a*) Lactation, being a physiological process, is not a drain upon the sys-

temic strength so long as the functions of nutrition are actively performed, but under other circumstances it very frequently becomes so. Premature weaning is necessary when the mother is attacked by any acute disease threatening dangerous temporary prostration, such as typhoid or typhus fever. A change must also be made if pulmonary consumption be developed, or, being already present, rapidly advances under the drain of milk-secretion. Usually, however, the general condition that leads to withdrawal of the breast is one of simple loss of strength and flesh on the part of the mother, and one which may often be overcome by attention to her health.

If the trouble be merely diminished milk-secretion, it may often be remedied by the free use of animal broths, chocolate, gruel, or milk, and sometimes the moderate employment of stimulants, in the form of ale and porter, may be necessary. Such tonics as malt extract, ferrated elixir of cinchona, bitter wine of iron, and the preparation known as "beef, wine, and iron," are useful when there is anæmia or when the general failure of strength cannot be overcome by food and attention to hygienic rules.

The ordinary local conditions indicating the necessity of premature weaning on the mother's account are fissures of the nipple and mammary abscess.

(*b*) On the part of the infant there are several indications for premature weaning. It must be done if the occurrence of pregnancy or the recurrence of menstruation renders the milk unwholesome; if the mother contract a dangerous contagious disease, as small-pox, scarlet fever, or erysipelas; if the mammary glands become inflamed; if the breast does not afford sufficient nourishment and artificial food be refused; and, finally, if dentition be markedly delayed and the premonitory symptoms of rickets appear.

Upon deciding to anticipate the time of weaning, the next point to consider is whether the infant shall be brought up by hand or by a wet-nurse.

2d. *Feeding by a Wet-nurse.*—The advantage of this mode of feeding is that the mother's milk is substituted by the milk of another woman; in other words, that natural feeding is continued—a matter of moment in all cases, and of inestimable importance with delicate children. The disadvantage consists in the difficulty of finding, in a woman belonging to the class from which wet-nurses come, all the moral and physical characters essential to a good substitute, and in the fact that a stranger is introduced into the household, often to deceive and annoy the family, and on the slightest provocation to leave her charge to fate or to the tender mercies of another of her kind. For these reasons it is preferable, in the majority of instances, to trust to careful bottle-feeding. Nevertheless, as some children must have human milk if their lives are to be saved, the rules for selecting a wet-nurse must be understood.

The woman chosen must be strong and robust, but rather spare than fat. Her bill of health must be perfectly free from hereditary tendency to mental or physical disease and from taint of syphilis, consumption, or scrofula. She must be cheerful, good-natured, active, careful, and temperate in habits. Her age should be between twenty and thirty years; she should understand the care of an infant and the manner of giving suck; her child ought to be nearly of the same age as the infant to be adopted, and she must be able to afford an abundant supply of good milk. The last quality can be estimated by inspecting the breasts, by examining some of the milk drawn by a pump, and by ascertaining the condition of the woman's own child. The breasts of a good nurse are not necessarily large, but are firm to the touch and pyriform in shape, with well-developed, prominent nipples, and with the skin distinctly marbled with large blue veins. The milk, which ought to flow readily on pressure or on suction, should be opaque and dull white in color, have a specific gravity of

1.031, an alkaline reaction, and show, when placed under the microscope, a number of minute, equal-sized fat-globules. Its quantity may be ascertained by weighing the child before and after sucking, the normal gain being from three to six ounces. There is, however, no better or more readily applied test of the quality of a nurse than the size, weight, and general development of her own child; and if it be weak and ill-nourished, no amount of fitness in other respects can warrant her engagement. Even when a woman is found fulfilling in her single person all the required conditions—a rare thing, indeed—it does not necessarily follow that her milk will suit the babe to be suckled. Then changes and new trials must be made until the desired end be attained.

3d. *Artificial Feeding.*—There are many women who, no matter how willing, are completely unable to suckle their babies, and a vast number in whom the secretion of milk fails after a few weeks or months of lactation. These must resort to a wet-nurse or to artificial feeding. Usually, they select the latter method.

To ensure success in hand-feeding—always a difficult task—it is important to make a detailed study of the following questions: *a*, the selection of a proper substitute for the natural food—the breast-milk; *b*, the quantity to be given; *c*, the method of preparation; *d*, the mode of administration; and, *e*, the means of preservation.

a. Healthy breast-milk must be taken as the type of infants' food, and the nearer an artificial substance can be made to approach it in chemical composition and physical properties the more perfect it is. Normal breast-milk has a specific gravity of 1.031. It is a persistently alkaline fluid, having a somewhat animal, usually disagreeable, and, very rarely, sweetish taste. It is bluish-white in color and thin and watery in consistence. It contains nitrogenous material (caseine), carbohydrates (milk-sugar and fat), salts, and water—all the elements essential to repair tissue-waste, to supply new material for growth, and to maintain body heat, or, in other words, to constitute a perfect aliment; and these, too, are so proportioned in the combination as to most easily and completely meet the demands.

In seeking a substitute for human milk one naturally turns to the domestic animals for the source of supply; cows' milk is usually selected, because, being plentiful, it is easily obtained and cheap.

Cows' milk (market milk) has a lower specific gravity than human milk—namely, 1.029; notwithstanding this, it is richer-looking—that is, whiter and more opaque; its reaction is slightly acid unless perfectly fresh from pasture-fed animals, when it may be neutral or alkaline. Its component ingredients are similar to those of human milk, but nitrogenous material exists in greater, the fat in somewhat less, and the sugar in far less proportion. The nitrogenous material also differs in quality, containing a much larger proportion of albumin coagulable by acids. This difference is readily tested by adding rennet to the two fluids. In the case of cows' milk the caseine is coagulated into large, firm masses, while with human milk a light, loose curd is formed. In the stomach the acid gastric juice has the same effect, producing in the first instance a coagulum most difficult to digest; in the other, one readily attacked and broken down by the gastro-intestinal solvents. These chemical and physical properties of cows' milk can be altered by various methods of preparation, and unless this be done there are few instances in which it will not prove a poor substitute for the natural food.

Condensed milk is frequently recommended by physicians, and largely used by the laity on their own responsibility. It keeps better than cows' milk, and is supposed to be more readily digested by young infants. The latter suppo-

sition is a mistaken one, and arises from the overlooked fact that condensed milk is always given dissolved in a large proportion of water, while cows' milk is too frequently used insufficiently diluted or otherwise improperly prepared. Condensed milk contains a large proportion of sugar, forms fat quickly, and thus makes large babies; sugar also counteracts the tendency to constipation —often a troublesome complaint in hand-feeding. These advantages are unquestioned, and, together with the ease of preparation, are those which place it so high in the esteem of monthly nurses. It is equally true, however, that as a food it contains too much cane-sugar, and not enough nutrient material to supply the wants of a growing baby. Infants fed upon it, though fat, are pale, lethargic, and flabby; although large, they are far from strong, have little power to resist diseases, often cut their teeth late, and are very liable to drift into rickets. It must be remembered also that condensed milk, when long kept or when packed in imperfect cans, not unfrequently undergoes decomposition, and thus becomes utterly unfit for use. For a temporary change of diet, however, and as a substitute during travelling or under circumstances in which sound cows' milk cannot be obtained, it may be resorted to with advantage.

The farinaceous substances so often selected, especially by the poor, to replace breast-milk, are not only bad foods, but have both directly and indirectly a deleterious effect upon the processes of nutrition. They are bad for two reasons: First, they differ materially in chemical composition from human milk. For example, in arrowroot, which is the favorite, the proportion of the tissue-building to the heat-producing element is as one to twenty, while in human milk it is about one to five. Secondly, the heat-producing principle, starch, must be converted into sugar before it can be absorbed. This change is accomplished in the body by the saliva and pancreatic juice—secretions that are not fully established until the fourth month. While the starch lies undigested in the gastro-intestinal canal it is subject to fermentation, resulting in the formation of irritant products that rapidly induce catarrh of the mucous membrane—a condition directly interfering with the digestion and absorption of food. Again, perfect nutrition demands rapid waste and removal of effete tissues as well as repair of the same. This is effected by oxidation. Now, sugars are known to have a much greater affinity for oxygen than albuminates, and when the diet consists of farinaceous material the small amount of sugar formed and absorbed appropriates oxygen that otherwise would go toward the removal of waste, and so retards the necessary changes. Farinaceous food, as such, is never permissible before the fourth month; earlier, it is only to be employed for its mechanical action as an addition to milk preparations. This will be mentioned later.

The nutrient value of the cereals and their products as they exist in so-called "infants' foods" has been imperfectly determined. They are undoubtedly useful as mechanical attenuants, but it is very questionable whether any of them, unless prepared with milk, can permanently meet the demands of nutrition. At the same time, it is quite probable that the soluble albuminoid substances obtained by Liebig's process have a food value of their own, making them more serviceable than the starches.

b. The quantity of food to be allowed each day varies with the appetite and age, and the question of the correct amount in a given case must be answered by observation. Nevertheless, it is well to have some guide. (See table, page 24 *et seq.*)

After the twelfth month the quantity depends upon whether additions be made to the diet or milk food be used exclusively. When the daily amount reaches three pints, the limit of the capacity of the stomach is usually attained,

and the greater demand for nutriment, as growth advances month by month, must be met by adding to the strength of the food rather than by increasing its bulk. These two factors, strength and quantity, are intimately associated throughout the whole period of infancy, and in the earlier months a mere increase in the latter is not always sufficient to maintain the balance of nutrition.

c. The object to be accomplished in the preparation of cows' milk is to make it resemble human milk as much as possible in chemical composition and physical properties. To do this it is necessary to reduce the proportion of caseine, to increase the proportion of fat and sugar, and to overcome the tendency of the caseine to coagulate into large, firm masses upon entering the stomach. Dilution with water is all that need be done to reduce the amount of caseine to the proper level; but as this diminishes the already insufficient fat and sugar, it is essential to add these materials to the mixture of milk and water. Fat is best added in the form of cream, and of the sugars either pure white loaf sugar or sugar of milk may be used. The latter is greatly preferable, as it is little apt to ferment and contains some of the salts of milk, which are of nutritive value. Firm clotting may be prevented by the addition of an alkali or a small quantity of some thickening substance. Lime-water is the alkali usually selected. It acts by partially neutralizing the acid of the gastric juice, so that the caseine is coagulated gradually and in small masses, or passes, in great part, unchanged into the intestine, to be there digested by the alkaline secretions. As it contains only half a grain of lime to the fluidounce, the desired result cannot be attained unless at least a third part of the milk mixture be lime-water. Instead of lime-water, two to four grains of bicarbonate of sodium may be added to each bottle, or, better still, from five to fifteen drops of the saccharated solution of lime.

This solution is made in the following way:

Take of—

Slaked lime	1 ounce.
Refined sugar, in powder	2 ounces.
Distilled water	1 pint.

Mix the lime and sugar by trituration in a mortar. Transfer the mixture to a bottle containing the water, and, having closed this with a cork, shake it occasionally for a few hours. Finally, separate the clear solution with a siphon and keep it in a stoppered bottle.

Thickening substances—attenuants, such as barley-water, gelatin, or one of the digestible prepared foods—act purely mechanically by getting, as it were, between the particles of caseine during coagulation, preventing their running together and forming a large, compact mass. To prepare the former, put two teaspoonfuls of washed pearl barley, with a pint of cold filtered water, into a saucepan; boil slowly down to two-thirds and strain. The liquid obtained does not possess the disadvantages of farinaceous foods generally. To be efficient, it must be used as a diluent instead of, and in the same proportion as, water. Gelatin is prepared in the following way: Put a piece of plate gelatin, an inch square, into a half-tumblerful of cold water, and let it stand for three hours; then turn the whole into a teacup; place this in a saucepan half full of water and boil until the gelatin is dissolved. When cold this forms a jelly; from one to two teaspoonfuls may be added to each bottle of milk food. When an "infants' food" is used to act mechanically, care should be taken to select one in which the starch has been converted into dextrin and grape-sugar by the process of manufacture.

The following table and schedule will aid in the practical understanding of the method of preparing food:

Table of the Ingredients, Hours and Intervals of Feeding, and Total Quantity of Food from Birth to the End of Seventh Month.

Age.	Cream.	Whey.	Milk.	Water.	Milk-sugar.	Salt.	A non-starchy Infants' Food.	Hours for Feeding.	Intervals of Feeding.	Total Quantity.	Remarks.
During 1st week	f℥ij	f℥iij	. .	f℥iij	gr. xx	. .	. .	5 A. M. to 11 P. M. Occasionally once or twice at night.	2 hours	f℥xij	Water must be hot.
From 2d to 6th week . . .	f℥ij	. .	f℥ss	f℥j	gr. xx	a pinch	. .	5 A. M. to 11 P. M.	2 hours	f℥xvij	
From 6th week to end of 2d month . . .	f℥ss	. .	f℥x	f℥x	℥ss	a pinch	. .	5 A. M. to 11 P. M.	2 hours	f℥xxx	
From 3d month to 6th month	f℥ss	. .	f℥iiss	f℥j	℥j	a pinch	. .	5 A. M. to 10.30 P. M.	2½ hrs.	f℥xxxij	
During 6th month — Morning and Midday.	f℥ss	. .	f℥ivss	f℥j	. .	. .	℥j	7 A. M. to 10 P. M.	3 hours	f℥xxxvj	Water must be hot to dissolve food.
During 6th month — Other Bottle.	f℥ss	. .	f℥ivss	f℥j	℥j						
During 7th month . . .	same	. .	same	same	same	. .	℥ij	same	same	same	same

Throughout the eighth and ninth months five meals a day will be sufficient. First meal, at 7 A. M.—

Milk . . . . . f℥viss.
Cream . . . . . f℥ss.
Milk-sugar . . . . . ℥j.
Water . . . . . f℥j.

Second meal at 10.30 A. M.—Milk, cream, and water in the same proportion; a reliable "infants' food," one tablespoonful. Third meal at 2 P. M.—same as second. Fourth meal at 6 P. M.—same as second. Fifth meal at 10 P. M.—same as first. This gives forty fluidounces of food per diem. Instead of "infants' food," a teaspoonful of "flour-ball" may be added. To make flour-ball, take a pound of good wheat flour—unbolted, if possible; tie it up very tightly in a strong pudding-bag; place it in a saucepan of water and boil constantly for ten hours; when cold, remove the cloth, cut away the soft, outer covering of dough that has been formed, and reduce the hard-baked interior by grating. In the yellowish-white powder obtained almost all the starch has been converted into dextrin by the process of cooking, and the proportion of the nitrogenous principle to the calorifacient is as one to five—nearly the same as human milk. Two meals of flour-ball daily—the second and fourth—are all that can be digested. To prepare these, rub one teaspoonful of the powder with a tablespoonful of milk into a smooth paste, then add a second tablespoonful of milk, constantly rubbing until a cream-like mixture is obtained. Pour this into eight ounces of hot milk, stirring well, and it is then ready for use. The other meals should be composed of milk, cream, sugar of milk, and water, as already given. Oatmeal or barley may also be used.

Diet for the tenth and eleventh months:
First meal, 7 A. M.—

Milk	f℥viiiss.
Cream	f℥ss.
One of the Liebig foods	℥ss.
(Or barley jelly)	℥ij.
Water (used only with the food)	f℥j.

Second meal, 10.30 A. M.—a breakfast-cupful of warm milk (eight fluidounces). Third meal, 2 P. M.—the yelk of an egg lightly boiled, with stale bread-crumbs. Fourth meal, 6 P. M.—same as first. Fifth meal, 10 P. M.—same as second. On alternate days the third meal may consist of a teacupful (six fluidounces) of beef tea[1] containing a few stale bread-crumbs. A further variation can be made by occasionally using mutton, chicken, or veal broth instead of beef tea.

As much more difficulty is experienced in feeding infants during the first twelve months than during the second, it would be well to pause here to consider what had best be done in case the food described should disagree.

If, after feeding, vomiting occur, with the expulsion of large, firm clots of caseine, the effect of adding lime-water or barley-water must be tried, both being added in the same quantity as the ordinary diluent—water.

Sometimes, particularly if there be diarrhœa, boiling makes the milk more tolerable; condensed milk, too, can be employed temporarily, making, for an infant of six weeks, each portion of—

Condensed milk	℥j.
Cream	f℥ss.
Hot water	f℥iiss.

Should further alteration be necessary, goats' or asses' milk may be substituted for cows' milk, the strong odor of the former and the laxative properties of the latter being removed by boiling. The milk should be used warm from the udder.

"Strippings" is another good substitute for cows' milk. It is obtained by remilking the cow after the ordinary daily supply has been drawn, and contains much cream and but little curd. One part of strippings to two of water or an equal measure of barley-water makes an easily digested mixture.

The process of predigestion or peptonization enables us to overcome many of the difficulties encountered in bottle-feeding. Pancreatin is the agent to be employed. That manufactured under the name of extractum pancreatis by Fairchild Brothers & Foster of New York has proved most efficient in my hands. To accomplish artificial digestion put into a clean quart bottle five grains of extractum pancreatis, fifteen grains of bicarbonate of sodium, and four fluidounces of cool filtered water; shake thoroughly together, and add a pint of fresh, cool milk. Place the bottle in water, not so hot but that the whole hand can be held in it for a minute without discomfort, and keep the bottle there for exactly thirty minutes. At the end of that time put the bottle on ice to check further digestion and to keep the milk from spoiling. The fluid obtained, while somewhat less white in color than milk, does not differ from it in taste: if, however, an acid be added, the caseine, instead of being coagu-

[1] Beef tea for an infant is made in the following way: Half a pound of fresh rump-steak, free from fat, is cut into small pieces and put, with one pint of cold water, into a covered tin saucepan. This must stand by the side of the fire for four hours, then be allowed to simmer gently (never boil) for two hours, and, finally, be thoroughly skimmed to remove all grease.

lated into large, firm curds, takes the form of minute soft flakes or readily broken-down, feathery masses of small size. When the process is carried just to the point described, the caseine is only partly converted into peptone, but every succeeding moment of continued warmth lessens the amount of caseine until peptonization is complete. Then the liquid is grayish-yellow in color, has a distinctly bitter taste, and shows no coagulation whatever on the addition of an acid.

"Peptogenic milk powder," prepared by the same chemists, has given me even better results than the pancreatin and soda. This powder contains a digestive ferment, pancreatin; an alkali, bicarbonate of sodium; and a due proportion of milk-sugar. The mode of employment is as follows:

Take of—

Milk	f℥ij.
Water	f℥ij.
Cream	f℥ss.
Peptogenic milk powder	1 measure.[1]

This mixture is to be heated slowly to boiling, ten minutes being occupied, and then quickly cooled. When properly prepared the resultant, so-called "humanized milk," presents the albuminoids in a minutely coagulable and digestible form; has an alkaline reaction; contains the proper porportion of salts, milk-sugar, and fat; is not bitter in taste, being but partially peptonized, and in appearance as well as chemical composition resembles human milk.

The great advantages of partial peptonization are that the necessity for lime-water, barley-water, and thickening substances to keep apart the curd is done away with, and that, when the digestive disturbance requiring a careful preparation of food is removed, an ordinary milk diet can be gradually resumed by regularly diminishing the time artificial digestion is allowed to progress. This changes the caseine in a less and less degree, until, finally, it is taken in its natural form.

"Sterilization" is another process of importance. As milk exists in the healthy cow's udder it is aseptic—*i. e.* free from any poisonous or dangerous ingredient—but during milking and subsequent handling and transportation various foreign materials get into it and are apt to set up some injurious change. To deprive these accidentally introduced organic impurities of their activity—or, in other words, to *sterilize*—it is necessary to subject the fluid to high heat under pressure.

Several admirable implements have been devised for conducting the process; one of the most simple, made after a design of my own, is shown in Fig. 1.

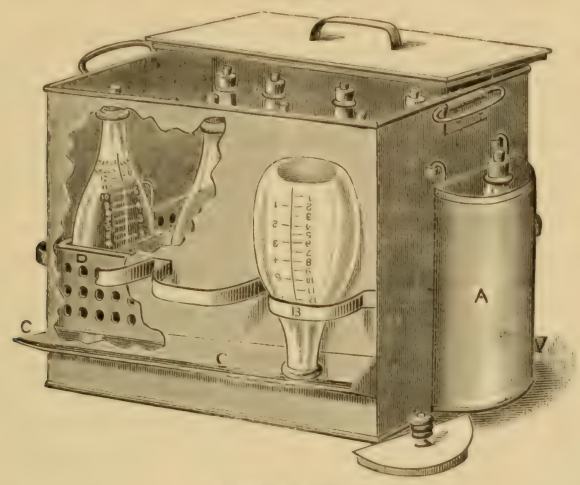
This apparatus is made of tin, and consists of an oblong case provided with a well-fitting cover, and having a movable perforated false bottom (D), which stands a short distance above the true one and has attached a framework capable of holding ten six-ounce nursing-bottles. On the outside of the case is a row of supports (B) for holding inverted bottles while drying, and at the proper distance below these a gradually inclining gutter (C) for carrying off the drip. A movable water-bath (A) is hung to the side; in this each bottle of food may be warmed at the time of administration. Ten graduated nursing-bottles are used, so that the whole supply of milk intended for a day's consumption can be prepared at once. Each bottle is provided with a perforated rubber cork, which in turn is closed by a well-fitting glass stopper.

Sterilization should be performed in the morning as soon as possible after

[1] Measure provided with each can of powder.

the milk has been served. The process is as follows: First, see that the ten bottles are perfectly clean and dry; pour into each six fluidounces of milk; insert the perforated rubber corks, without the glass stoppers, however; remove the false bottom and place the bottles in the frame; pour into the

Fig. 1.



Author's Sterilizer.

case enough water to fill it to the height of about two inches; replace the false bottom carrying the bottles; adjust lid and put the whole on the kitchen range. Allow the water to boil, and, by occasionally removing the lid, ascertain that the expansion that immediately precedes boiling has taken place in the milk; then press the glass stoppers into the perforated corks, and thus hermetically close each bottle. After this keep the apparatus on the fire and the water boiling for twenty minutes. Finally, remove the false bottom with the bottles; pour out the water, replace and carry the whole, covered with the lid, to the nursery.

Milk sterilized by this process will remain sound for many days: it is especially useful in travelling, when fresh milk cannot be obtained; for use in cities during the heat of summer, when milk is most apt to undergo injurious changes; for a temporary change of food in delicate children or for those suffering from disease of the stomach or intestinal canal. It must be remembered, however, that the prolonged heating produces certain changes in the composition of the milk which make it more difficult to digest, and that on this account many children do not thrive upon it.

Another process of sterilization, suggested by Leeds, is free from this disadvantage, and has proved most useful in my practice. It consists in heating the milk, rendered feebly alkaline with lime-water or sodium bicarbonate, to 155° F. for six minutes, or, better still, of applying the same amount of heat to milk with pancreatin and bicarbonate of sodium or with peptogenic milk powder. By the latter method the milk is both predigested and sterilized; if not used at once, it must be momentarily heated to the boiling-point to check peptonization before the development of a bitter taste.

According to Rowland G. Freeman, the problem that presents itself in the sterilization of milk for food is to devise a method which shall destroy by efficient means the contained germs, and yet in the least possible degree interfere with its nutritive qualities. The experiments of Leeds show that

sterilization at the boiling-point of water causes the following modifications: the starch-liquefying ferment is destroyed and coagulated; caseine is rendered less coagulable by rennet, and is acted on slowly and imperfectly by pepsin and pancreatin; proteid matters attach themselves to fat-globules, and probably bring about a less perfect assimilation of fat; while milk-sugar, by prolonged heating, is completely destroyed. Koplik states that "from the temperature of 75° C. upward there is a separation of the serum-albumin of the milk; the caseine loses its coagulability to rennet, and at 85° C. amounts of rennet which for the raw condition of milk are found sufficient to act cease to be effective." Hueppe considers that from a physiological standpoint milk is best sterilized under a temperature of 75° C., while other experimenters have shown that temperatures lower than 100° C., if continued for a short time, will destroy a very large proportion of the germs, and will destroy with certainty many pathogenic germs which find their way into milk either from the cow or as external contaminations.

Dr. Freeman, therefore, feels satisfied that Pasteurization offers the most rational solution of the question under consideration. The elaborate and recent experiments of Yersin, Granchier, Lidoux-Libard, and Bitter show that the bacillus tuberculosis in milk will be destroyed in ten minutes by an exposure to 75° C., in fifteen minutes to 70°, and in thirty minutes to 68°. Concerning other bacteria, Van Geuns found that a few seconds' exposure to 60° would kill the cholera spirilla, the Finkler-Prior bacillus, the typhoid bacillus, and the pneumococcus of Friedländer.

It may, therefore, be concluded that a temperature of not less than 158° F. will render milk sufficiently germ-free for infant food, and that a temperature of less than 176° F. will not injure milk materially. Methods of Pasteurizing milk in bulk have been brought forward both in Germany and in this country; and now the procedure has been brought down to an easily-managed system for household use. This depends upon the theory that the temperature of the milk to be treated may be raised to about the desired point (167° F.) by immersing a certain definite quantity of milk in a properly proportioned bulk of boiling water, the source of heat having been removed. The apparatus consists of two parts, a graduated pail for the water and a receptacle for the bottles of milk. This receptacle consists of a series of seven or ten hollow zinc cylinders fastened together, which fits into the pail containing the boiling water. Each of these cylinders is large enough to hold one of the bottles of milk, the series of seven cylinders accommodating seven eight-ounce bottles, and the series of ten cylinders being intended for ten six-ounce bottles. When the bottles are in place water is poured around them to secure perfect conduction of the heat. After the water in the pail is thoroughly boiling, it is removed from the stove and placed on a non-conducting surface. The cylinders are now introduced, and the pail covered and left standing for thirty minutes, after which the milk is rapidly cooled in a refrigerator or by cold water or ice and water. Milk thus treated and put immediately into a refrigerator usually shows no change for several days.

Sometimes milk, in every form and however carefully prepared, ferments soon after being swallowed and excites vomiting, or causes great flatulence and discomfort, while it affords little nourishment. With these cases the best plan is to withhold milk entirely for a time and try some other form of food. The following are good substitutes:

Veal broth ($\frac{1}{2}$ lb. of meat to the pint) . . . . . f $\bar{3}$iss.
Barley-water . . . . . f $\bar{3}$iss.

Or, Whey . . . . . f℥iss.
Barley-water . . . . . f℥iss.
Milk-sugar . . . . . ʒss.
For one portion; to be given every two hours at the age of two months.

A teaspoonful of the juice of raw beef every two hours will usually be retained when everything else is rejected. Such foods are only to be used temporarily until the tendency to fermentation within the alimentary canal ceases; then milk may be gradually and cautiously resumed.

When infants approaching the end of the first year become affected with indigestion, it is often sufficient to reduce the strength and quantity of the food to a point compatible with digestive powers. For instance, at eight months the food may be reduced to that proper for a healthy child of six months or even less. Here, too, predigestion of the food is very serviceable. If a few grains of extractum pancreatis be added to a gobletful of thick, well-boiled starch gruel at a temperature of 100° F., the gelatinous mucilage quickly grows thinner, and soon is transformed into a fluid, the starch having been rendered soluble by the action of the pancreatin; by still longer contact the hydrated starch is converted into dextrin and sugar. Advantage may be taken of this property to render the foods containing starch assimilable. Thus, to a mixture of barley jelly and milk—*e. g.*

Barley jelly . . . . . ʒij,
Milk sugar . . . . . ʒj,
Warm milk . . . . . f℥viij,

add three grains of extractum pancreatis and five grains of bicarbonate of sodium, and keep warm for half an hour before administering.

The same process may be employed with food containing oatmeal, arrow-root, or wheaten flour, or in the case of meat broths, with a view of converting the starchy and albuminoid ingredients into digestible elements without materially altering the taste.

Returning to the regimen of the healthy infant, it will be found that after the first year far less change is required in the food from month to month.

Diet from the twelfth to the eighteenth month, five meals per day: First meal, 7 A. M.—a slice of stale bread, broken and soaked in a breakfast-cup (eight fluidounces) of new milk. Second meal, 10 A. M.—a teacup of milk (six fluidounces), with a soda biscuit or thin slice of buttered bread. Third meal, 2 P. M.—a teacup of beef tea (six fluidounces), with a slice of bread; one good tablespoonful of rice-and-milk pudding. Fourth meal, 6 P. M.—same as first. Fifth meal, 10 P. M.—one tablespoonful of Mellin's Food, with a breakfast-cupful of milk.

To alternate with this: First meal, 7 A. M.—the yelk of an egg lightly boiled, with bread-crumbs; a teacupful of new milk. Second meal, 10 A. M.—a teacupful of milk, with a thin slice of buttered bread. Third meal, 2 P. M.—a mashed baked potato, moistened with four tablespoonfuls of beef tea: two good tablespoonfuls of junket. Fourth meal, 6 P. M.—a breakfast-cupful of new milk, with a slice of bread broken up and soaked in it. Fifth meal, 10 P. M.—same as second.

The fifth meal is often unnecessary, and sleep should never be disturbed for it; at the same time, should the child awake an hour or more before the first meal, he must break his fast upon a cup of warm milk, and not be allowed to go hungry until the set breakfast hour.

Diet from eighteen months to the end of two and a half years, four meals

a day: First meal, 7 A. M.—a breakfast-cupful of new milk; the yelk of an egg lightly boiled; two thin slices of bread and butter. Second meal, 11 A. M. —a teacupful of milk, with a soda biscuit. Third meal, 2 P. M.—a breakfast-cupful of beef tea, mutton or chicken broth; a thin slice of stale bread; a saucer of rice-and-milk pudding. Fourth meal, 6.30 P. M.—a breakfast-cupful of milk, with bread and butter.

On alternate days: First meal, 7 A. M.—two tablespoonfuls of thoroughly cooked oatmeal or wheaten grits, with sugar and cream; a teacupful of new milk. Second meal, 11 A. M.—a teacupful of milk, with a slice of bread and butter. Third meal, 2 P. M.—one tablespoonful of underdone mutton pounded to a paste; bread and butter, or mashed baked potato moistened with good plain dish gravy; a saucer of junket. Fourth meal, 6.30 P. M.—a breakfast-cupful of milk, a slice of soft milk toast or a slice or two of bread and butter.

When sickness supervenes, all that is ordinarily necessary is a reduction of the diet to plain milk or some easily digestible milk mixture.

An important point, often neglected, is the matter of drink. Even the youngest infant requires water several times daily, and the demand increases with age. The water must be as pure as possible, and should not be too cold. In the heat of summer, however, bits of ice and water moderately cooled by ice can be allowed without harm.

The foregoing schedule must, of course, be regarded only *as an average.* Many children can bear nothing but milk food up to the age of two or even three years, and, provided enough be taken, no fear for their nutrition need be entertained. If a child be thriving on milk, he is never to be forced to take additional food merely because a certain age has been reached; let the healthy appetite be the guide.

d. Success in hand-feeding depends quite as much on the administration as upon the preparation of the food.

From birth up to such time as broth, bread, and eggs are added to the diet all the food should be taken from a bottle. Even after this, as the bottle is a comfort and ensures slow feeding, it may be allowed for milk preparations until the child, of his own accord, tires of it. The only feeding apparatus to be admitted to the nursery is the simple bottle and tip. The bottle made after my suggestion, and known as the "graduated nursing-bottle," has an interior surface free from angles, so that it is readily kept clean, and is provided with a scale for the measurement of ounces and half-ounces. It is made of transparent flint glass, so that the slightest foulness can be detected at a glance, and may vary in capacity from six to twelve fluidounces according to the age of the child. Two should be on hand at a time, to be used alternately. Immediately after a meal the bottle must be thoroughly washed out with scalding water, filled with a solution of bicarbonate or salicylate of sodium—one teaspoonful of either to a pint of water—and thus allowed to stand until next required; then, the soda solution being emptied, it must be thoroughly rinsed with cold water before receiving the food. The tips or nipples, of which there should also be two, must be composed of soft, flexible India-rubber, and a conical shape is to be preferred, as being more readily everted and cleaned; the opening at the point must be free, but not large enough to permit the milk to flow in a stream without suction. At the end of each feeding the nipple must be removed at once from the bottle, cleansed externally by rubbing with a stiff brush wet with cold water, everted and treated in the same way, and then placed in cold water and allowed to stand in a cool place until again wanted.

Next to cleanliness of the feeding apparatus it is important to insist upon the separate preparation of each meal immediately before it is to be given. The

practice of making, in the morning, the whole day's supply of food, though it saves trouble, is a most dangerous one. Changes almost invariably take place in the mixture, and by the close of the day it becomes unfit for consumption.

The food must be administered at a temperature of about 95° F. It may be heated by steeping the bottle containing the food in hot water or by placing it in a water-bath over an alcohol lamp or gas-jet.

When feeding, the child must occupy a half-reclining position in the nurse's lap. The bottle should be held by the nurse, at first horizontally, but gradually more and more tilted up as it is emptied, the object being to keep the neck always full and prevent the drawing in and swallowing of air. Ample time—say five, ten, or fifteen minutes, according to the quantity of food—should be allowed for the meal. It is best to withdraw the bottle occasionally for a brief rest, and after the meal is over sucking from the empty bottle must not be allowed, even for a moment.

e. For children residing in cities an honest dairyman must be found who will serve sound milk and cream from country cows once every day in winter, and twice during the day in the heat of summer. The milk of ordinary stock cows is more suitable than that from Alderney or Durham breed, as the latter is too rich, and therefore more difficult to digest. The mixed milk of a good herd is to be preferred to that from a single animal: it is less likely to be affected by peculiarities of feeding, and less liable to variation from alterations in health or different stages of lactation.

The care of the herd and of the milk is of great consequence. The cows should be healthy, and the milk of any animal that seems indisposed should be excluded. The cows must not be fed upon swill or the refuse of breweries, glucose-factories, or any other fermented food. They must not be allowed to drink stagnant water, and must not be heated or worried before being milked. The pasture must be free from noxious weeds, and the barn and yard must be kept clean. The udder should be washed, if dirty, before the milking. The milk must be at once thoroughly cooled. This is best accomplished by placing the can in a tank of cold spring-water or in ice-water, the water being the same depth as the milk in the can. It is well to keep the water in the tank flowing; indeed, this is necessary unless ice-water be used. The can should remain uncovered during the cooling, and the milk should be gently stirred. The temperature should be reduced to 60° F. within an hour, and the can must remain in the cold water until the time for delivering. In summer, when ready for delivery, the top should be placed in position and a cloth wet in cold water spread over the can, or refrigerator cans may be used. At no season should the milk be frozen, and at the same time no buyer should receive milk having a temperature over 65° F.

For transportation from the dairy it is safer for the family to provide two sets of small cans—one set to be thoroughly cleansed and aired, while the other is taken away by the milkman to bring back the next supply. So soon as this arrives in the morning, or in the morning and evening in hot weather, the milk should be emptied into separate and absolutely clean earthenware or glass pitchers, and these put at once into a refrigerator reserved exclusively for them. This may stand in some convenient spot near the nursery, but not in it, and especially not in an adjoining bath-room. With a good refrigerator there is no difficulty in keeping milk perfectly sweet for twenty-four hours in winter and for twelve hours in summer, except on intensely hot days; then it may be necessary to scald, slightly boil, or sterilize the whole of the supply when received, in order to prevent change.

Childhood.—Children who have cut their milk teeth may be fed for a

twelvemonth—namely, up to the age of three and a half years—in the following way: First meal, 7 A. M.—one or two tumblerfuls of milk, a saucer of thoroughly cooked oatmeal or wheaten grits, and a slice of bread and butter. Second meal, 11 A. M. (if hungry)—a tumblerful of milk or a teacupful of beef tea with a biscuit. Third meal, 2 P. M.—a slice of underdone roast beef or mutton or a bit of roast chicken or turkey, minced as fine as possible; a baked potato thoroughly mashed with a fork and moistened with gravy; a slice of bread and butter; a saucer of junket or rice-and-milk pudding. Fourth meal, 7 P. M.—a tumblerful of milk and one or two slices of well-moistened milk toast.

From three and a half years up the child must take his meals at the table with his parents, or with some reliable attendant who will see that he eats leisurely. The diet, while plain, must be varied. The following list will give an idea of the food to be selected:

BREAKFAST.

Every Day.	*One Dish only Each Day.*	
Milk.	Fresh fish.	Eggs, plain omelette.
Porridge and cream.	Eggs, lightly boiled.	Chicken hash.
Bread and butter.	" poached.	Stewed kidney.
	" scrambled.	" liver.

Sound fruits may be allowed before and after the meal, according to taste, as oranges, without pulp, grapes (seeds not to be swallowed), peaches, thoroughly ripe pears, and cantaloupes.

DINNER.

Every Day.	*Two Dishes Each Day.*	
Clear soup.	Potatoes, baked.	Hominy.
Meat, roasted or broiled,	" mashed.	Macaroni, plain.
and cut into small	Spinach.	Peas.
pieces.	Stewed celery.	String-beans, young.
Bread and butter.	Cauliflower.	Green corn, grated.

Junket, rice-and-milk, or other light pudding, and occasionally ice cream, may be allowed for dessert.

SUPPER.

Every Day.

Milk.
Milk toast or bread and butter.
Stewed fruit.

Fried food, highly seasoned or made-up dishes are to be excluded, and no condiment but salt is to be used. Eating, however little, between meals must be absolutely avoided. Keep a young child from knowing the taste of cakes or bonbons, or, having learned it, let him feel that they are as unattainable as the thousand other things beyond his reach, and he soon ceases to ask for them. Even a piece of bread between meals should be forbidden. His appetite then remains natural, and he will eat proper food at his regular meal hours. As to the quantity, a healthy child may be permitted to satisfy his appetite at each meal, under the one condition that he eats slowly and masticates thoroughly. Filtered or spring water should be the only drink, tea, coffee, wine, or beer being entirely forbidden.

In case of illness the diet must be reduced in quantity and quality, according to the rules that are applicable to adults.

2. Bathing.

During the first two and a half years of life a child ought to be bathed once every day. The bath should be given at a regular time, and it is best to

select some hour in the early morning, midway between two meals—ten o'clock, for instance. The tub should be placed near the fire or in a warm room in winter, and away from currents of air in summer. It should contain enough water to cover the child up to the neck when in a sitting posture, and the temperature must be about 95° F. Upon undressing the child the first step is to wet his head; then he is to be plunged into the water and thoroughly washed with a soft rag or sponge and pure, unscented castile soap. After remaining in the water from three to five minutes the surface must be well dried and rubbed with a flannel cloth or soft towel; then the body must be enveloped in a light blanket and the infant either returned to his crib to sleep or kept in the lap for ten or fifteen minutes until thoroughly warm and rested, and finally dressed. If there be repugnance to the bath, the tub may be covered over with a blanket, and the child, being placed upon it, may be slowly lowered into the water without seeing anything to excite his fears. In very hot weather, in addition to the morning full bath, the body may be sponged twice daily with water at a temperature of 90° F.; this, contrary to what might be expected, has a greater and more permanent cooling effect than bathing with cold water.

After the third year three baths a week are quite sufficient. An evening hour is now to be preferred, but the water must still be heated to 90°. About the tenth year cooler baths can be begun, from 72° to 75° being the proper temperature. The cold sponge or cold plunge is not admissible as a daily routine until youth is well advanced.

The hot bath—95° to 100° F.—is employed for various purposes, notably for a derivative action, to cause diaphoresis, to relieve nervous irritability, and to promote sleep. Whether a full bath or merely a foot-bath be required, five minutes is a sufficient time for immersion; then, with or without drying, according to the degree of sweating desirable, the whole body, or only the feet and legs in case of a foot-bath, must be enveloped in a blanket, and the child put to bed. To render these baths more stimulating, from a teaspoonful to a tablespoonful of mustard flour may be added, and the child held in the water until the *arms* of the nurse begin to tingle. It is important not to continue a hot bath too long, lest the primary stimulating effect be followed by depression.

Cold baths, by shocking the system, first produce depression: but this is temporary and is followed by reaction, during which the skin grows red and the pulse becomes fuller and stronger. They have, therefore, a general stimulant and tonic action, promoting nutrition and giving tone to the body. On account of the shock, the extent of which depends directly upon the coldness of the water, these baths must be used with caution, and are not to be employed in very young or feeble subjects. When giving a cold bath, the child must be stripped in a warm room, and thoroughly rubbed with the palm of the hand until the whole body, especially the spinal region, is reddened; he must then stand in a tub containing enough hot water to cover the feet, and be rapidly sponged with the cold water. The temperature of the latter must never be below 60°, and the addition of half an ounce of sea-salt or a tablespoonful of concentrated sea-water to the gallon renders it more stimulating and ensures a complete reaction. After the sponging the surface must be thoroughly and quickly dried with a soft towel and shampooed with the open hand until aglow.

The cooled bath may be employed with advantage in extreme conditions of hyperpyrexia. The child is first immersed in water at 95°, and this is gradually lowered to 70° by the addition of cold water, the process occupying from fifteen to thirty minutes.

3. Clothing.

Infants and young children have little power of resisting cold, and on this account require warm clothing. The condemnation of the fashion of allowing children to go, even while in the house, with bare legs and knees must be absolute. Occasionally during the most oppresive heat of a summer midday the legs may be left uncovered; but with this exception the rule is to keep the whole body encased in woollen underclothing. The thickness of this must vary, of course, with the season. Providing this be done, the outer clothing may be left to the taste of the mother; but all garments should fit loosely, that the functions of the different viscera may not be impeded by pressure.

The best pattern of a winter night-dress is a long, plain slip, with a drawing-string at the bottom, to prevent exposure of the feet and limbs should the child kick off the bed-covering. This should be made of flannel or the more easily washed canton flannel. In summer a loose muslin one may be put on, without the drawing-string. A flannel under-vest should always be worn at night, light gauze in summer and heavier wool in winter; care must be taken, however, to have one for night alone, discarding that worn in the daytime.

In infants under a year old a broad flannel abdominal bandage, extending from the hips well up to the thorax, or, better still, a knitted worsted band shaped to fit the form, is very useful in keeping the abdominal organs warm, aiding digestion and preventing pain.

All clothing should be changed sufficiently frequently to ensure cleanliness.

Shoes must be large, well shaped, and made of soft leather with pliable soles, so as to allow the feet to grow freely.

When dressing a child for exercise in the open air in cold weather, the outer clothing must not be put on until just before leaving the house, and removed immediately on return. It is important to protect the head from cold in winter by a close-fitting, thick cap, and from the direct rays of the sun in summer by a broad-brimmed, light straw hat. Rubber shoes are necessary in wet weather to keep the feet warm and dry while walking out of doors.

4. Sleep.

For some time after birth infants spend the intervals between being fed, washed, and dressed, in sleep, and thus pass fully eighteen out of the twenty-four hours. As age advances the amount of sleep required becomes less, until at two years thirteen hours, and at three years eleven hours, are enough. This matter, though, is perhaps more a question of training than any other item of nursery regimen, and one cannot too soon begin to form the good habit of regularity in sleeping hours. So far as circumstances will admit, the following rules may be enforced:

From birth to the end of the sixth or eighth month the infant must sleep from 11 P. M. to 5 A. M., and as many hours during the day as nature demands and the exigencies of feeding, washing, and dressing will permit. From eight months to the end of two and a half years a morning nap should be taken from 12 M. to 1.30 or 2 P. M., the child being undressed and put to bed. The night's rest must begin at 7 P. M. If a late meal be required, the child can be taken up at about ten o'clock; but if past the age for this, he may sleep undisturbed until he wakes of his own accord some time between 6 and 8 A. M. From two and a half to four years, an hour's sleep may or may not be taken in the morning, according to the disposition of the subject; but in every case the bed must be occupied from 7.30 P. M. to 6 or 7 o'clock on the following morning. After the fourth year few children will sleep in the daytime; they are ready for

bed by 8 P. M., and should be allowed to sleep for ten hours or more. A later retiring hour than 9 P. M. ought not to be encouraged until after the twelfth or fifteenth year.

When feasible, different rooms should be used for the day nursery and the sleeping apartment. If an apartment has to be occupied during both the day and night, it must be vacated for half an hour or more in the evening and well aired before the child is put to bed. The temperature of the room must be as uniform as possible, the proper degree of heat being from 64° to 68° F.

5. Exercise.

A certain amount of muscular exercise is necessary for development and for the proper performance of the digestive functions. Infants before they are able to stand will use their muscles sufficiently if, when loosely clad, they are placed upon their backs in a bed and allowed to kick and turn about at pleasure. After the age of nine or ten months a healthy child will begin to creep; at the end of a year he will make efforts at standing, and from four to eight months later will be able to walk by himself; children, however, present great differences in this respect, and a delay of a few months must not be considered as abnormal. So soon as efforts at creeping are made there need be no fear that insufficient exercise will be taken: the care should be rather to prevent over-fatigue. Fresh air and sunlight are as necessary as muscular exercise. The child must be taken out of doors every day, weather permitting, after arriving at the proper age: this is four months for children born in the early fall and winter, and one month for those born in summer. In cool weather babies who are unable to walk should be taken out in a coach or in the nurse's arms for an hour in the morning and half an hour in the afternoon, while the sun is shining. In summer they may pass the greater part of the waking hours in the open air, provided they be well protected from the direct rays of the sun. Children old enough to walk may spend a longer time in the air in winter, and may be out all day in summer. But until the fourth year it is better to let them play about at will than take a long set walk. Until well advanced in childhood the house is the safest place in damp and rainy weather, when there is a strong east or north wind blowing, and when the thermometer stands below 15° F.

III. General Remarks on Treatment.

It is difficult to formulate a precise, reliable, or handy posological table; in fact, the whole matter of dosage for children is one of experience, and with practice every one makes his own dose-list in his mind, and the proper amount of a given drug for a given age requires as little effort of memory as in the case of adults. Nevertheless, as a guide to the student, Cowling's rule is serviceable—namely, the proportionate dose for any age under adult life is represented by the number of the following birthday divided by 24—*i. e.* for one year, $\frac{2}{24} = \frac{1}{12}$; for two years, $\frac{3}{24} = \frac{1}{8}$; and so on.

All powerful drugs must be given with caution to children, but opium requires the greatest care. Infants bear it only in infinitesimal proportions, and in these its use is to be avoided as much as possible: still, combined with castor oil, it is a useful drug in bad cases of flatulent colic, the average commencing dose in the first six weeks of life being not more than $\mathfrak{m}\frac{1}{32}$ of the tincture (laudanum). After the second or third month the extreme susceptibility to the drug disappears, and $\mathfrak{m}\frac{1}{4}$ of laudanum may be given for a dose.

Bromide of potassium, a most valuable remedy in many diseases, must be given to infants with watchfulness, as it sometimes, even in small doses, produces severe local inflammations of the skin and localized patches of soft, warty growths.

Belladonna and arsenic are illustrations of an opposite tendency, for children are very tolerant of these drugs, particularly the first. A child of four or five years can readily take from two to five minims of tincture of belladonna, and in cases in which it is necessary to administer arsenic to choreic children of six years and upward a commencing dose of five minims of Fowler's solution may often be given three times daily, and a considerable increase in this be attained if required. Such initial doses are, however, occasionally productive of the symptoms of mild arsenical poisoning, and therefore it is well to begin with one- or two-minim doses and increase rapidly. This rule applies especially to children belonging to the wealthier classes, for these, like their parents, are much more sensitive to drugs than hospital patients—an undoubted physiological fact of wide bearing.

Alcohol is frequently indicated and is of great value, but it must be used with judgment. It is most useful in broncho-pneumonia, severe febrile conditions; in the prostration following measles, diphtheria, and whooping cough; and in the collapse that frequently attends severe thoracic or abdominal disease.

All drugs should be made as palatable as possible.

In conclusion, it must be remembered that children do not often require energetic treatment with drugs. Proper feeding and hygiene are of most importance in the management of disease in early life.

THE CHEMISTRY OF MILK AND OF ARTIFICIAL FOODS FOR CHILDREN.

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I. The Chemistry of Milk.

The peculiar adaptation of milk to the feeding of the young depends upon its unique combination of chemical and physical properties. It contains in well-balanced proportions the three essential elements of nutrition—the nitrogenous, or tissue-building; the carbohydrate, or heat-giving; and the fats. Along with these are a sufficiency of saline substances to carry on the chemical metamorphoses of cell-formation, of secretion and excretion, and an ample supply of water as the universal solvent. These substances are held partly in a state of solution, partly in a state of semi-solution, conferring upon milk its slightly colloidal consistency, and partly in suspension, producing its appearance of density and opacity. But it contains no waste material like the indigestible fibre and cellulose of flesh, fruit, and vegetables. Neither does it exhibit a development of one or two elements of nutrition at the expense of the third, as is the case with all other foods,—even eggs, which most nearly approach milk in this respect, not being excepted. Finally, almost no preparation before, during, or after swallowing is requisite for the absorption of milk through the rudimentary digestive apparatus of the young.

The chemistry of woman's milk can be well and effectively studied for our present purposes only in connection with that of cow's milk. For at the very outset a peculiar difficulty is experienced in attempting to procure a sample of the former, which does not exist in the case of the latter. Some sort of a breast-pump or similar appliance must be used, and this unnatural process yields at the best but a partial sample. This fact explains many of the great and anomalous variations exhibited in the analyses. It also renders the conclusions drawn from an isolated analysis of little value: and in practice it is wiser to base any conclusions as to the sufficiency and quality of the breast-milk upon the condition and yield of the gland, upon the physical condition and nutrition of the mother, and, most of all, upon the development of the child and its deportment in nursing.

On the other hand, innumerable analyses of complete samples of cow's milk exist, embracing every variety of breed, under every condition of climate, age, culture, and feeding.

Cow's Milk.—On no other article of food has such elaborate care been expended, both as to its production and chemical investigation. Most civilized communities have enacted laws to protect its purity, and recognize no evidence in courts of law except when substantiated by adequate chemical testimony.

Similar investigations are being constantly made with a view of so adjusting the feeding and the breed as to obtain the largest quantity of milk or the greatest richness, or both. Beginning with cattle of small, imperfectly-developed udders, the cow has become through generations of culture the incomparable milk-secreting animal of modern nations, and has so far displaced the ass, goat, mare, and others that it is useless to consider their milk as an available substitute.

For similar reasons, the cow's milk which must be considered from the standpoint of general dietetics is such sound, whole country milk as is ordinarily supplied by reputable dealers. It is useless to quote the analyses of the milk of Alderney, Jersey, and Guernsey cattle, obtainable only by the few; and when obtained, such milk, with its higher percentage of proteids and its greater liability to variation from idiosyncrasy in condition or health of individual cattle, is not to be preferred over that of the average milk of large herds properly bottled before being sent to market. So likewise as to the composition of the "strippings" of the udder. They are not usually procurable, and their greater richness in fat and deficiency in casein can be better arrived at, even when ordinary whole milk is used, by appropriately modifying its composition.

Limiting our consideration strictly to commercial bottled milk, it becomes of the greatest importance to inquire into the present conditions regulating its production and handling at the farm, during transit, and in delivery to the consumer. Hitherto, these conditions have fallen far short of the requirements which chemical and medical science should rightly impose upon milk as the prime article of artificial infant nutrition. The State laws have checked the adulteration of milk by addition of water and removal of cream, but as yet have done little, and that only incidentally, in the way of guaranteeing its wholesomeness and improving its quality. In fact, enlightened public sentiment, assisted and directed by the medical profession, will do more in this direction than can be expected at present from the State. And the same remark is true of the efforts of the dairyman. What is being done and should be done is best exemplified by a recital of the provisions of a legal contract drawn up between a committee of certain medical societies in the vicinity of New York on the one hand and a competent dairyman on the other. The latter undertakes that his herd of Holstein and Jersey cattle shall be regularly and frequently inspected by a veterinarian selected by the committee and paid by the dairyman. All cattle that are pronounced by the surgeon, for any cause whatsoever, disqualified to produce pure sound milk are forthwith excluded from the herd. Interbreeding more frequently than the fourth generation is interdicted. The cattle must be kept in a large, well-ventilated, well-lighted stable, with ample space and no overcrowding, with abundance of pure water for drinking and cleansing; with perfect drainage; with dry cemented floors; with clean fresh bedding of hay; and with arrangements for securing them in the stall which shall give ample liberty to the movements of the head and for lying down, but shall do away with the necessity of chains or other fastening. Separate stalls and partitions, as interfering with ventilation and cleanliness, are done away with. The cow-stables must be removed from those in which horses, chickens, and other stock are kept by so great a distance that the cattle can in no wise come in contact with the other animals. The cows must be groomed daily, and the teats washed before each milking. The milkmen must perform their own toilets before milking, being especially required to thoroughly cleanse their hands and to remove the dirt beneath the finger-nails, wearing also unsoiled clothing. The feeding is to be regulated by the season in such

wise that the milk produced shall conform to the highest feasible standard of excellence. Abundance of wholesome pasture, hay, meal, fodder, and ensilage is demanded, but the refuse of glucose-factories, brewers' grains, swill in any form, etc. are interdicted. There are also provisions in the contract that the cattle shall not be worried, heated, or driven, or milked except after proper interval after calving. The milking must be done with scrupulously cleansed vessels; the milk filtered through fine metallic gauze, then cooled in a dust-free atmosphere in such wise as to lower the temperature as rapidly as possible, and also to permit the escape of the gases along with the animal heat; and, finally, transferred to bottles rendered as nearly sterile by cleansing with boiling water and steam as possible. These jars, which must be entirely full, are closed by a metallic cover, sealed, transferred to boxes with a layer of ice on top of them, and delivered at an early hour in the day, the temperature of the milk never being allowed to rise in the interval above 50° F. The dairyman further undertakes to pay for the services of a competent chemist and biologist, who shall frequently test the milk, and whose analyses and certificates shall accompany it. He also undertakes to have his stables, cattle, feed, bottling arrangements, etc. open at all proper times to inspection, and to comply with all other requirements of the committee which they in their judgment shall deem essential to securing the highest attainable degree of quality and purity. The only obligation which the committee assumes is that it permits the milk to be sealed with a label bearing the name of the dairy and the dairyman, and the legend "Certified Milk," and to be accompanied by the certificate of purity bearing the name of the committee, the chemist, biologist, and veterinarian.

Milk in the human gland or cow's udder, when tuberculosis or kindred disease is absent, contains no bacteria. Indeed, by rejecting the first portions and excluding floating particles in the air, sterile cow's milk can be obtained, and contrivances to this end have been patented; but they are quite impracticable. So likewise is the proposition to sterilize all the milk before it leaves the farm by heating it at 230° F. for a sufficient length of time completely to destroy every spore which might by any possibility be present. Consumers would not pay for the skill, time, and apparatus required, and the process itself produces unfavorable changes in the milk. The first portion of this objection applies also to the proposition that the milking should be done directly into sterilized bottles, and the milk then Pasteurized by heating to a temperature of 160°–170° for twenty minutes.

Any of the bacteria present in the air, water, ground, or derived from the diseased or filthy condition of those who handle the milk at any time, or arising from the animals themselves, may possibly find their way into milk. And, inasmuch as this fluid is an excellent culture-medium, they multiply with great rapidity. But these things demand suitable care for their prevention, and not a care involving the compulsory sterilization of all milk. The author believes that no more should be required of the dairyman than the reasonable precautions above detailed, which self-interest also demands. Then a false security will not be placed in legal requirements sure to be evaded or neglected, and necessitating an army of skilled inspectors, veterinarians, and chemists to enforce. The few ounces of milk needed for artificial nursing are best sterilized immediately before use, and this is best done in the course of the preparation essential to adapt it for infant feeding, either just before transfer to the bottle or in the bottle itself. By so doing, the fact, usually lost sight of, will be kept constantly in mind—that the same precautions as to the bottle, nipple, the water used, the exclusion of floating particles from the milk, and the keeping of it in a refrigerator are as essential to preserving the sterility of the milk as

its sterilization in the first instance. Washing in boiling water cannot be trusted to remove the adherent skin of fat and casein on the milk-vessels; some soda must be used: the rubber nipple should be turned inside out over the finger and scrubbed with a brush and precipitated chalk.

Supposing that the present enlightened public sentiment has secured such a legalized system of sanitary cattle-inspection and milk-control as to make the reasonable precautions now exercised voluntarily by honorable dairymen obligatory upon all, bottled milk, which I shall term "sound dairy milk," presents the following characteristics: In color it varies from white to yellow. Even when allowed to fall in drops from the end of a rod it exhibits a dense white opacity and consistency, the fluidity and bluish-white color of watered or inferior milk being absent. It is almost neutral, reddening litmus-paper very feebly. On standing, the cream rises in the neck of the quart bottle commonly used until it forms a layer about two and a half inches in depth. These physical characters are all that need be noted. If they are absent, if the milk is thin and watery, if it has a bluish, blue, strong yellow, or red color, if it is stringy, lumpy, or glutinous, if it has a flat, stale, sour, or any abnormal taste or odor,—it is simply to be rejected, and its investigation left to the milk inspector and chemist.

Many analyses of such bottled milk afford me the following average results, which are given as preliminary to the still better figures that will come with "certified milk:"

Fats	3.75 per cent.
Lactose (milk-sugar)	4.42 "
Albuminoids	3.76 "
Ash	0.68 "
Total solids	12.61 per cent.

In some of the States the legal standard calls for 12.5 per cent. of total solids and 3 per cent. of fat. It is much to be deplored that in other States, as in New Jersey, the standard demands only 12 per cent., and unless the fat falls below 2½ the milk is assumed to be unskimmed. It was made thus low in order that no lack of care in housing and cleanliness, no inadequacy of feeding, no abstraction of cream from the evening milk (half-skimming), and no accidental or judicious watering should bring the owner or vendor under condemnation of law. For the same reasons it is assumed that any milk which has a higher specific gravity than 1.029 at 60° F. (100° on the lactometer scale) is pure, whereas the average of sound dairy milk should be 1.0297.

Human Milk.—Having given the above general characteristics of cow's milk, it is necessary to do the same for human milk, and then proceed to a more specific comparison of their resemblances and differences. And in the first place, while all the conditions and environment are arranged to develop the milk-secreting function of milch cattle, in the human family, on the other hand, they are more and more ignored as women become burdened with the increasing duties and dissipations of modern society. The regular life with moderate enjoyments, exercise, and occupation, the simple nourishing diet, with abundance of fresh air and rest, which are most favorable to the milk-secretion, are sacrificed, with the result of arresting or diminishing the flow and deteriorating the quality of the milk. Stimulants, narcotics, improper or highly-seasoned food, functional disorders with their attendant medicines, violent emotions and paroxysms of grief, anger, and pain, render the milk unwholesome and sometimes dangerous. As a contribution to the chemistry

of this subject I give in an accompanying table the results of 80 analyses of samples of milk obtained from women of different nationalities, age, stage of lactation, and physical constitution, but all living in a lying-in hospital under the same conditions and eating the same food. (See pp. 42 and 43.)

The analyses are arranged according to the period of lactation, except in cases where several samples were taken, these following consecutively. Many hundred analyses would be required to determine what differences, if any, are due to nationality or to the physical characteristics of the mother—whether black, blonde, or brunette, or, more minutely, the color of the eyes, hair, complexion, etc. But the influence of the physical condition was pronounced, the best milk not coming from women of robust habit (Column I.), but from those whose nourishment appeared rather in the milk-secretion than in the fattening of the mother (Column II.):

	I. (6 cases).	II. (6 cases.)
Fats	3.71	3.96
Lactose	6.94	6.74
Albuminoids	1.44	2.12
Ash	0.25	0.22
Total solids	12.34	13.04

The reaction of every sample was alkaline, the alkaline reaction persisting during one or more days. The color varied from bluish-white through chalky-white to strong yellow, but the color was not a necessary index of the composition: the milk of a German (No. 34), which was the richest in fats (6.89 per cent.), lactose, and total solids, was chalky-white in color, while that of another German (No. 8), which was yellow, was very low in fats, having only 2.31 per cent. Though the amount of lactose is more than a third greater than in cow's milk, yet the taste can hardly be called sweet, and while the total solids (13.27) and the specific gravity (1.0313) are both higher than in cow's milk, yet the consistency is much thinner. This is due to its much smaller content of albuminous matters, more especially of the caseinous or cheesy material.

The average amount of nitrogenous matters (albuminoids) is somewhat greater at beginning of lactation, but the difference is not very marked. In truth, the feature brought out by this long series of analyses, which overshadows every other in significance, is the fact that there is no progressive change in the composition of milk during lactation, but after the function has been normally established the milk remains substantially the same during the entire period. This is what might be anticipated from what much larger experience teaches in regard to cow's milk, but it is at variance with notions commonly entertained, and which have led to elaborate and utterly useless dietaries for infant nutrition. The child obtains more nutriment day by day, but it is by spontaneously increasing the quantity according to the best rule, which is that of normal appetite, and not by absorbing "stronger and stronger food."

Comparison of Cow's Milk and Human Milk.—Before proceeding farther, the general characteristics may advantageously be summed up in the following comparison:

	Sound Dairy Milk.	Woman's Milk.
Reaction	Feebly acid.	Persistently alkaline.
Specific gravity	1.0297	1.0313
Bacteria	Always present.	Absent.
Fats	3 to 6 —average, 3.75	2 to 7 —average, 4.13
Lactose	3.5 to 5.5— " 4.42	5.4 to 7.9 — " 7.0
Albuminoids	3 to 6 — " 3.76	0.85 to 4.86— " 2.0
Ash	0.6 to 0.9— " 0.68	0.13 to 0.37— " 0.2

TABLE OF ANALYSES OF SAMPLES OF MILK FROM WOMEN OF DIFFERENT NATIONALITIES, AGE, ETC.

1.	2.	3.	4.	5.	6.		7.	8.	9.	10.	11.	12.	13.	14.
No.	Mother's age.	Nationality.	Color of hair.	Period of lactation.	Breast.		Interval since nursing.	Color of milk.	Specific gravity.	Albuminoids.	Lactose.	Fat.	Ash.	Total solids.
					Right.	Left.								
13	28	German	Brown . . .	1 day.	. . .	L.	2 hours.	. . . . .	1.030	2.40	6.45	6.01	0.22	15.08
14	28	German	Dark brown .	1 "	. . .	L.	2 "	. . . . .	1.032	2.52	6.44	4.95	0.27	14.18
7	19	Irish	Dark brown .	2 days.	½ R.	½ L.	5 "	Yellow	1.034	3.12	6.47	5.49	0.32	15.40
18		Nos. 7–35, same mother.	. . . . .	6 "	½ R.	½ L.	. . .	Dull white . . .	1.033	3.95	7.92	4.37	0.22	16.46
28	. .		. . . . .	19 "	. . .	L.	. . .	White	1.031	2.23	7.39	2.95	0.21	12.78
35			. . . . .	29 "	½ R.	½ L.	. . .	White	1.032	2.43	7.34	3.13	0.21	13.11
47	26	American . . .	Brown . . .	2 "	½ R.	½ L.	2 "	Yellow	1.032	4.86	5.40	3.36	0.20	13.82
6	33	Pole	Dark brown .	2 "	R.	. . .	5 "	Yellowish-white .	1.030	1.45	7.24	3.20	0.24	12.13
38	20	German	Brown . . .	2 "	½ R.	½ L.	3 "	White	1.021	1.82	6.96	3.97	0.19	12.94
15	22	German . .		3 "	. . .	L.	2 "	. . . . .	1.032	2.18	6.75	2.84	0.13	11.90
16				5 "	. . .	L.	. . .	Yellow	1.030	0.85	5.50	6.16	0.22	12.73
26	. .	No. 15 to No. 30, same mother.	Light, a typical blonde.	13 "	. . .	L.	2 "	. . . . .	1.030	2.08	6.98	3.28	0.20	12.54
29				17 "	. . .	L.	. . .	White	1.030	1.81	6.88	2.80	0.20	11.69
30				27 "	½ R.	½ L.	. . .	Yellowish-white .	1.031	2.11	7.41	5.04	0.20	14.76
40	24	Negress	Black	3 "	½ R.	½ L.	20 min.	Yellow	1.032	1.75	6.94	3.68	0.28	12.65
64	24	Hungarian . .	Black	3 "	R.	. . .	30 "	. . . . .	1.0312	2.00	6.69	3.96	0.32	12.97
8	29	German	Light brown.	4 "	. .	L.	4½ hours.	Yellow	1.030	2.15	6.51	2.31	0.28	11.25
45	22	American . . .	Brown . . .	5 "	½ R.	½ L.	2 "	Yellowish-white .	1.031	2.33	7.48	2.47	0.16	12.44
67	28	Scotch	Fair	5 "	½ R.	½ L.	30 min.	. . . . .	1.0322	1.96	7.28	4.74	0.30	14.28
41	23	Irish	Black	6 "	½ R.	½ L.	30 "	White	1.031	2.45	6.08	3.82	0.19	12.54
21	18	English . . .	Black	8 "	R.	. . .	1 hour.	. . . . .	. . .	. . .	. . .	. . .	0.22	13.01
32	28	German	Dark brown .	10 "	½ R.	½ L.	0 min.	Yellowish-white .	1.030	1.53	5.84	5.62	0.14	13.13
34	23	German	Brown . . .	10 "	½ R.	½ L.	1 hour.	Chalky-white . .	1.034	2.19	7.46	6.89	0.25	16.79
33	23	Irish	Dark brown .	11 "	½ R.	½ L.	0 "	Yellow	1.030	2.24	6.25	2.76	0.35	11.60
65	. .	Dane	Light	12 "	½ R.	½ L.	1 "	. . . . .	1.0319	2.25	7.12	5.85	0.15	15.37
4	23	Irish	Dark brown .	13 "	. . .	L.	3 hours.	. . . . .	1.0346	1.73	7.25	2.95	0.18	12.11
39	23	Irish	Brown . . .	13 "	½ R.	½ L.	0 "	Yellowish-white .	1.030	2.33	5.78	4.21	0.21	12.53
48	22	American . . .	Red	17 "	½ R.	½ L.	2 "	Yellowish-white .	1.032	1.93	6.95	5.59	0.18	14.65
31	20	German	Dark brown .	19 "	½ R.	½ L.	½ hour.	Chalky-white . .	1.033	2.27	6.75	5.96	0.15	15.13
24	29	Italian	Black	20 "	½ R.	½ L.	¼ "	. . . . .	1.030	1.94	7.45	3.61	0.16	13.16
9	29	Irish	Brown . . .	22 "	. . .	L.	5 hours.	. . . . .	1.032	2.05	7.08	3.00	0.13	12.26
51	16	American . . .	Dark brown .	23 "	. . .	L.	2 "	Yellow	1.030	2.42	6.95	5.60	0.19	15.16

68	22	German	Light brown.	23 days.	½ R.	½ L.	1 hour.	. . . . .	1.0317	2.17	7.44	4.36	0.29	14.26
3	19	German	Brown . . .	25 "	. .	L.	4½ hours.	White	1.0353	1.96	7.31	4.62	0.18	14.07
5	21	Irish	Brown . . .	26 "	½ R.	½ L.	6 "	White	1.030	1.49	7.23	2.12	0.18	11.02
2	21	Irish	Dark brown .	27 "	R.	. . .	2 "	. . . . .	1.0351	1.68	7.53	3.55	0.21	12.97
66	25	German	Dark brown .	30 "	½ R.	½ L.	½ hour.	. . . . .	1.0307	1.11	7.07	2.73	0.22	11.13
12	23	Irish	Brown . . .	41 "	. . .	L.	5 hours.	. . . . .	1.031	1.76	6.97	2.44	0.20	11.37
1	19	German,	Brown . . .	45 "	½ R.	½ L.	5 "	Yellow	1.0321	1.44	7.20	5.58	0.17	14.39
17		same as 1	. . . . .	49 "	½ R.	½ L.	. . .	Yellow	1.034	1.49	7.37	5.02	0.17	14.05
11	18	German	Light brown.	46 "	. . .	L.	3 "	. . . . .	1.031	1.98	6.99	3.06	0.20	12.23
20	30	Slavonic . . .	Brown . . .	50 "	½ R.	½ L.	½ hour.	. . . . .	. . .	. . .	. . .	. . .	0.30	14.08
23	26	Bohemian . . .	Brown . . .	53 "	R.	. . .	1 "	. . . . .	1.030	2.10	6.61	4.02	0.20	12.93
10	25	Scotch	Brown . . .	82 "	. . .	L.	5 hours.	. . . . .	1.030	1.43	7.19	2.11	0.19	10.92
53	19	Irish	Red	88 "	½ R.	½ L.	2 "	White	1.029	1.82	6.83	4.28	0.37	13.30
27	28	German	Light brown.	89 "	¼ R.	¾ L.	¾ hour.	. . . . .	1.031	1.98	7.00	2.44	0.21	11.63
52	25	Swedish	Light	90 "	½ R.	½ L.	2 hours.	White	1.030	2.15	6.76	6.78	0.16	15.85
55	27	German	Brown . . .	93 "	½ R.	½ L.	3 "	White	1.026	2.43	6.57	4.94	0.27	14.21
25	20	Irish	Brown . . .	115 "	. . .	L.	2 "	. . . . .	1.032	2.16	7.00	5.84	0.22	15.22
19	23	Irish	Dark brown .	126 "	½ R.	½ L.	1 hour.	. . . . .	. . .	. . .	. . .	. . .	0.15	12.34
54	19	German	Dark brown .	132 "	½ R.	½ L.	2 hours.	Yellowish-white .	1.030	1.59	7.34	3.10	0.18	12.12
43	30	American . . .	Brown . . .	150 "	½ R.	½ L.	2 "	Chalky-white . .	1.031	1.50	7.32	3.77	0.18	12.77
42	20	Irish	Brown . . .	167 "	½ R.	½ L.	2 "	White	1.031	1.97	7.38	4.16	0.25	13.76
22	33	Swedish	Brown . . .	180 "	½ R.	½ L.	¼ hour.	. . . . .	. . .	. . .	. . .	. . .	0.21	12.74
44	25	American . . .	Light	180 "	½ R.	½ L.	2 hours.	White	1.030	1.49	7.31	4.34	0.21	13.35
46	24	Mulatto	Black	186 "	½ R.	½ L.	2 "	White	1.031	1.35	7.24	4.09	0.31	12.99
50	21	American . . .	Light brown.	217 "	½ R.	½ L.	2 "	White	1.031	2.06	6.39	4.75	0.2[illegible]	13.42
49	19	Irish	Light brown.	270 "	½ R.	½ L.	2 "	White	1.031	2.00	6.95	4.64	0.21	13.80
60	25	Scotch	Light brown.	21 "	½ R.	½ L.	5 min.							
61	28	German	Brown . .	12 "	½ R.	½ L.	5 "							
62	30	Irish	Black	27 "	½ R.	½ L.	5 "	. . . . .	1.0296	1.95	7.02	3.85	0.22	13.04
63	22	Irish	Light brown.	19 "	½ R.	½ L.	5 "							
56	. .	French	Dark brown .	210 "	R.	. . .	1 hour.							
57	. .	Irish	Brown . . .	90 "	R.	. . .	2 hours.							
58	. .	Irish	Dark brown .	153 "	½ R.	½ L.	2 "	. . . . .	1.0297	1.16	7.41	4.74	0.21	13.52
59	. .	Irish	Light brown.	92 "	R.	. . .	2 "							
36								Yellow	1.031	2.43	7.23	3.79	0.22	13.67
37	. .	. . . . .	Descriptions	lost . . .	. . .	. . .	. . .	Chalky-white . .	1.032	1.60	7.55	6.21	0.22	15.58
								Maximum . .	1.0353	4.86	7.92	6.89	0.37	16.79
								Minimum . .	1.0260	0.85	5.40	2.11	0.13	10.92
								Average . . .	1.0313	1.995	6.936	4.131	0.201	13.268

On an average, human milk has about ½ of 1 per cent. more fat than average sound dairy milk, and 2¼ per cent. more lactose. On the other hand, it has ½ of 1 per cent. less mineral matter, and, what is most important, *but 2 per cent. of albuminoids, or about half the quantity in cow's milk.* The fat is the most variable constituent, as is the case in cow's milk also. But in both the sum of all the other constituents besides fat is a nearly constant quantity, amounting in the vast majority of samples to about 9 per cent. The significance of this physiological fact must not be lost sight of. It shows that the final tendency and result of the complicated metabolic changes, which take place in the protoplasmic cells of the mammary gland, is to secrete a nearly constant total amount of nitrogenous, carbohydrate, and saline material, while allowing the secreted fat to exhibit a wide and independent variability. An increase in the amount of nitrogenous food does not increase the nitrogenous element in the milk secreted by a nursing woman beyond the general limit implied in the above rule, the metabolism in this case resulting in an increase of the fat. An excess of fat, on the other hand, diminishes the metabolism. And, as a practical deduction from the above, there results the necessity of feeding a nursing woman on a diet which shall contain a sufficiency of proteid matters, but not on a rich food, the former yielding by transformation not only the albuminoids, but also the fats and lactose of the milk, whilst the latter may not in this sense be nourishing, and may impair the metabolic activity whereby the due proportion of the various constituents of the milk is normally maintained.

It is necessary to the further understanding of the problem of infant nutrition, and especially of artificial feeding, to study in detail the similarities and differences of the individual constituents of woman's and cow's milk.

Lactose.—The lactose in the two secretions is chemically, physically, and physiologically identical. The statements based on clinical results to the effect that the lactose of cow's milk exerted a peculiar diuretic action and produced glycosuria and set up abnormal digestive fermentations, etc. will have to be reviewed. Until very recently all the samples of lactose coming into my laboratory, even those supplied by manufacturers of highest repute as chemically pure, were far from being so. They contained residues of the proteids of milk and spores, the taste, appearance, and properties of the lactose being thereby altered. So great is the present use of lactose in medicinal preparations that correspondingly great improvements have been made in its manufacture, resulting in the production of a very pure, hard, white, transparent, crystalline substance.

The carbohydrate element, which is made up of starches, the many varieties of sugar, etc. in the food of adults, and which constitutes the largest part of most vegetables and fruits, is represented in milk by lactose only. This body is intermediate in its chemical properties between cane-sugar and starch, being, like the former, soluble, but with a taste hardly perceptibly sweet. Its main function is to supply by oxidation the animal heat, and, inasmuch as the human infant cannot maintain its animal heat by locomotion, and yet at the same time this heat must be preserved at even a higher temperature than that of the adult, the lactose is relatively the largest constituent of human milk, forming more than one-half its total solid matter. Being already in a soluble condition, it is directly assimilable, and, unlike starch, requires little or no expenditure of energy to effect its transformation prior to digestion. Under the influence of certain bacteria, acting as ferments, the lactose is decomposed, with the formation of lactic acid. Up to the present time ten varieties of bacteria, including, along with the bacillus acidi lactici, certain species of micrococci and sphæro-

cocci, have been described as more especially concerned in the lactic fermentation of milk. They all bring about the curdling of the milk, but some of them at the same time give rise to the formation of gas and alcohol, and others do not. The primary change is due to the simple splitting of the molecule of lactose into four molecules of lactic acid by addition of a molecule of water:

$$\underset{\text{Lactose.}}{C_{12}H_{22}O_{11}} + H_2O = \underset{\text{Lactic acid.}}{4(C_3H_6O_3)}$$

This change, which is the ordinary normal one, ensures the curdling and the development of lactic acid initiative to milk digestion. Under the influence of other ferments the molecule of lactic acid may break up into a molecule of alcohol and carbonic acid ($C_3H_6O_3 = C_2H_6O + CO_2$), but this decomposition is secondary and abnormal, and takes place less readily and more slowly than the decomposition of grape-sugar, glucose, or dextrose into alcohol and carbonic acid under like circumstances.

Besides this fermentation, which results in the separation of a curd by means of lactic acid, there is another fermentation, which is accompanied by the development of a neutral or alkaline reaction. In this case the curd first formed may all eventually pass into solution, being converted into soluble peptones. The bacteria giving rise to these changes originate two soluble substances acting as ferments, one acting like rennet to curdle the milk, the other dissolving the curd and exerting a peptonizing action. There is also produced leucin, tyrosin, ammonia, and, more especially, butyric acid, which last body gives its name to this kind of fermentation. Artificially, it is induced by contact with putrid cheese. In the digestive tract the butyric fermentation is usually brought about by the prolonged stay in the bowels of the undigested curds of milk or of a foreign irritant substance like starch, or by both. It is essentially a process of putrefactive decomposition, not present in normal digestion. In its simplest form the change may be represented by the formula

$$\underset{\text{Lactic acid.}}{2C_3H_6O_3} = \underset{\text{Butyric acid.}}{C_4H_8O_2} + \underset{\text{Carbonic acid.}}{2CO_2} + \underset{\text{Water.}}{2H_2O}$$

While starch is the principal carbohydrate of adult food, it cannot properly be used in infant feeding on account of the absence of the ferment essential to its digestion. This starch-digesting ferment exists under the name of ptyalin in the saliva, and also is present to some extent in the pancreatic juice, but its amount in infants is very small, and its secretion is not established until after the third month. By its action the starch is made to take up a molecule of water and then decompose into maltose and dextrin, the latter body, by continuance of the same action, passing into dextrose; thus:

$$\underset{\text{Starch.}}{3(C_6H_{10}O_5)} + H_2O = \underset{\text{Maltose.}}{C_{12}H_{22}O_{11}} + \underset{\text{Dextrin.}}{C_6H_{10}O_5}$$

$$\underset{\text{Dextrin.}}{2(C_6H_{10}O_5)} + 2H_2O = \underset{\text{Dextrose.}}{2(C_6H_{12}O_6)}$$

Liebig proposed to effect this change by means of the diastase contained in malt, and his suggestion has been extensively followed. But the objection still remains that the saccharine substances thus produced, like the vegetable sugars in general, are not the same carbohydrate which is normally present in milk, and it has not as yet been satisfactorily established that they undergo in digestion the same series of changes and oppose equal resistances to abnormal fer-

mentation. Though cane-sugar or sucrose, malt-sugar or maltose, and milk-sugar or lactose, all belong to the same general class of sugars known as saccharoses, with the formula $C_{12}H_{22}O_{11}$, yet their physical and chemical properties are essentially different, and so also their behavior when in presence of certain ferments.

Fat.—So far as is known at present, the principal difference between the fat-globules of woman's and cow's milk is in the relatively greater size of the former, which vary between 0.001—0.02 mm., while the latter average 0.00014—0.0063 mm. in diameter. The assumption that each globule is surrounded by a membranous envelope has been disproved, the finely-divided fat existing as naked globules, on the surface of each of which a number of albuminous molecules are condensed by molecular attraction, and the coalescence of the fat particles thereby hindered.

Albuminoids.—While the lactose of human and cow's milk is identical, and the fats are very similar, the nitrogenous portion presents so many and important differences that the question of the successful substitution of cow's milk for human principally depends upon whether or no these differences can be compensated or overcome. In both secretions the nitrogenous portion consists mainly of casein and lactalbumin. In addition, there are substances of the nature of peptones, in small quantities, but to what extent they exist naturally, and to what degree, in the case of cow's milk, they are formed by the peptonizing action of bacteria, is not at present determined. Casein is an acid body existing in milk in combination with alkali, forming principally potassium caseinate. But the reactions of this body are complicated by the presence of other mineral bodies, and more especially of calcium phosphate. When dilute acid is added the casein of cow's milk readily precipitates in coarse coagula or clots, but that of woman's milk requires more acid for its precipitation and separates not in lumps, but in a fine powder which dissolves in excess of the acid. The lactalbumin remains in solution in the whey after separation of the casein. By boiling it is rendered insoluble. It closely resembles serum-albumin. While in cow's milk the total fraction of the albuminoids precipitable by acid (casein) exceeds by about four times the non-coagulable portion, in human milk these proportions are reversed, the non-coagulable part being about twice the coagulable portion. Similar differences exist in the coagulum formed by the acid gastric juice: in the one case an excess of insoluble cheesy masses, in the other a relatively small amount of finely divided soluble flakes, being formed. Taking equal weights of the two secretions, the coagulum of woman's milk is but one-fifth as much as that of cow's milk. The comparative smallness of this quantity must be as carefully considered as the difference in the compactness and solubility of the coagula themselves. It explains the rapidity with which infant digestion is overtaxed even by small amounts of undiluted cow's milk.

Inorganic Matter.—The mineral matter in cow's milk is more than three times that in woman's milk, and especially great is the excess of calcium phosphate, which is four times larger. This excess is due to the correspondingly larger amount of casein in cow's milk, with which substance the calcium phosphate and the potash are principally combined. The soda appears to exist in solution along with the lactalbumin as common salt. It is noteworthy that the lime is already relatively greater in the cow's than in human milk, and it is open to serious question whether the practice of using cow's milk alkalized by excess of lime is as desirable, in the case of normal digestion, as it was thought to be before the composition and properties of the constituents of milk were known. The following table presents the relative composition of

the ash of cow's milk (Fleischmann) and of woman's milk (König), and also the percentages of each constituent (Bunge):

	Cow's Milk.		Woman's Milk.	
Potash	24.5	0.18	33.78	0.07
Soda	11.0	0.11	9.16	0.03
Lime	22.5	0.16	16.64	0.03
Magnesia	2.6	0.02	2.16	0.01
Oxide of iron	0.3	0.0004	0.25	0.0006
Phosphoric acid	26.0	0.2	22.74	0.05
Sulphuric acid	1.0	—	1.89	—
Chlorine	15.6	0.17	18.38	0.04

II. The Chemistry of Artificial Foods.

Two methods have been followed in the attempt to solve the problem of artificial feeding. The easier, and that most generally adopted, which would also appear to be the more natural method, is that of attempting to produce a food which should resemble as closely as possible woman's milk. The other method aims to produce a food or foods which should be especially adapted to the demands of nutrition for each particular infant in health or disease: it is open to great diversities of opinion, due to opposing clinical experiences, and is adapted rather to the treatment of special cases of disordered digestive and other functions than to common use. By general consent the advocates of the first method have selected cow's milk as the basis upon which to build. The difficulty of obtaining cheaply, readily, and of proper quality the milk of the ass, the goat, or of any other animal than the cow, has rendered the discussion of the possible advantages of such milk quite useless.

Dilution.—The first expedient in connection therewith was that of dilution with water until the percentage of albuminoids and salts should approximate to that in woman's milk. But no amount of dilution with water alone is adequate to prevent the separation of the curd in coarse, indigestible lumps in presence of the acid secretions of the stomach. The next device was the addition of an excess of lime-water, so as to partly neutralize the gastric juice and allow much of the milk to pass unchanged from the stomach and undergo digestion in the bowels. As the chemistry of the milk salts indicates, the excess of lime is abnormal, and its addition is an expedient to meet a therapeutic condition connected with an over-development of acidity, and not to change the nature of the difficultly digestible casein itself.

Predigestion.—To effect this latter change previous digestion with dilute acid and pepsin was resorted to, and latterly this gave place to the more successful digestion with pancreatin in alkaline solution. Both methods were confined to cases of greatly impaired digestion, and the predigestion was carried as far as possible. But inasmuch as in woman's milk there naturally remains about one-fifth of the albuminoids in a caseinous condition, the most recent practice is that of using a limited amount of pancreatin, acting for so short a period that the process shall initiate the peptonization, and then be arrested by the destruction of the ferment. The casein is thereby left in such a condition that it separates on acidifying as a fine white powder, while the biuret reaction for the albuminates becomes strongly developed.

Sterilization.—Recently the fact that woman's milk contains no bacteria, while cow's milk usually contains large numbers and many kinds, pathogenic species possibly included, has been strongly insisted upon. To overcome this objection the practice of sterilizing the milk by repeated heating to a temperature above the boiling-point of water has been extensively followed.

So far as the destruction of all bacteria and their spores is concerned, the process is successful, but the clinical results which have attended the use of such sterilized milk have revealed serious drawbacks. It prevents the spread of zymotic diseases through the medium of milk; it is efficacious in checking many gastro-intestinal disorders; but its continued use is accompanied by a failure to afford adequate nutrition. Besides the destruction of the bacteria, the prolonged heating to or above the boiling-point brings about other changes which are in the nature of deteriorations. More especially the lactalbumin loses its solubility, and the fat-globules are made to coalesce with one another and some of the insoluble albuminous matter. For these reasons the application of continued heat in the process of sterilization is inadvisable, and is now being discontinued.

Sterilization at a Low Temperature (Pasteurization).—In this process of preparation the milk is kept for a brief interval, ten to twenty minutes, at a temperature of 160°–170° F., or raised during heating continued for ten minutes just to the boiling-point. While this process will not destroy all the germs which are in the form of spores, it will destroy the spores of tuberculosis, scarlet fever, pneumonia, and typhoid, and almost completely inhibit the existence of the developed spores, or bacteria, of every kind.

Pasteurization with Partial Predigestion (Humanized Milk).—The adjustment of the lactose and the bringing about of a permanently alkaline reaction are effected by the presence in the diluted sterilized milk of such an amount of lactose and of the alkaline milk salts as will effect this result. In order to raise the percentage of fat to that contained in woman's milk, cream may be added, or some vegetable oil like olive or cocoa, or animal oil like that of cod-liver. At present, by the aid of the Leval separator, cream has become a commercial article easily obtained, and its use is more convenient and better understood than that of the other fat substitutes, which require to be further investigated. Inasmuch as it contains some casein and bacteria, due allowance must be made for both in the process of modification heretofore explained. In practice, by the use of a preparation of pancreatin, lactose, and alkaline milk salts originated by Fairchild Brothers & Foster of New York, and known as "Peptogenic Milk-powder," the author has found that with ordinary bottled milk, cream, and water a modified sterilized milk is obtained which corresponds so closely to woman's milk that he has given it the name of "humanized" milk. The proportions recommended are—

Milk	½ pint.
Water	½ pint.
Cream	4 tablespoonfuls.
Peptogenic Milk-powder	1 large measure.

The mixture is heated on a hot range or gas-stove with constant stirring, the heating being so conducted that at the end of ten minutes it is brought to the boiling-point. The temperature of 160° to 170° is high enough to destroy the ferment, and this temperature, continued for twenty minutes, kills the bacteria also. But it is so much easier to quickly raise the temperature for a moment to the boiling-point, which also effects both objects, that the latter method is to be preferred when by a process of partial peptonization, as in the process described, the main portion of the albuminoids has been brought to a permanently soluble form.

The milk thus prepared is slightly alkaline and sterile. It contains, according to the author's analyses, bottled market milk being used in its preparation, the following proportions of constituents:

Fat	4.5 per cent.
Albuminoids	2.0 "
Lactose	7.0 "
Ash	0.3 "
Total solids	13.8 per cent.

When lime is used to counteract not only the slight acidity of market milk, but also with the object of forming a soluble calcium caseinate which will not be decomposed by the acid of the gastric juice and curds of casein thereby precipitated, the lime must be added in considerable quantities. A mixture of 2 ounces of milk, 2 ounces of lime-water, and 2 ounces of cream, to which a teaspoonful of sugar of milk has been added, contains only a grain of lime, a quantity too small to effect any notable chemical change of the casein. If this mixture is sterilized, it should be done at a temperature between 160° and 170°, since heating to the boiling-point causes some decomposition of the albuminoids in presence of alkali.

"Condensed Milk."—When condensed milk is used the preceding remarks require to be somewhat modified on account of the different modes of preparing this substance. This will be readily understood by comparing the composition of (I.) milk condensed with added cane-sugar, mean of forty-one analyses; (II.) the same diluted with eight times its weight of water; (III.) Anglo-Swiss milk, preserved without added sugar; (IV.) American-Swiss, preserved; (V.) No. III. diluted with five times water.

	I.	II.	III.	IV.	V.
Fat	12.10	1.51	13.21	11.55	2.64
Albuminoids	16.07	2.01	11.36	14.10	2.27
Lactose	16.62	2.08	15.29	13.04	3.05
Sucrose	22.26	2.78			
Ash	2.61	0.32	1.78	2.09	0.36
Total solids	69.66	8.70	41.64	40.78	8.32
Water	30.34	91.30	58.36	59.22	91.68

When largely diluted with water, so that the percentage of albuminoids is approximately the same as in human milk, the fat and lactose are brought far below the quantity proper for infant nutrition. Nor is the deficiency adequately supplied by the added sucrose of the milks condensed with this substance. Referring to these points, Dr. Louis Starr justly remarks: "Condensed milk is frequently recommended by physicians, and largely used by the laity on their own responsibility. It keeps better than cow's milk, and is supposed to be more readily digested by infants. The latter supposition is a mistaken one, and arises from the overlooked fact that condensed milk is always given dissolved in a large proportion of water, while cow's milk is too frequently used insufficiently diluted or otherwise improperly prepared. The author is convinced of the accuracy of this statement from a number of years' close study of the subject. Condensed milk contains a large proportion of sugar, forms fat quickly, and thus makes large babies; sugar also counteracts the tendency to constipation—often a troublesome complaint in hand-feeding. These advantages are unquestioned, and, together with the ease of preparation, are those which place it so high in the esteem of monthly nurses. It is equally true, however, that as a food it does not contain enough nutrient material to supply the wants of a growing baby. . . . . It must be remembered also that condensed milk, when long kept or when packed in imperfect cans, not infrequently undergoes decomposition, and thus becomes utterly unfit for use."

Attenuation.—An entirely different method of increasing the digestibility

of the casein is that of adding farinaceous or gummy substances, the action of which is not chemical, but mechanical, and depends upon the separation which they effect of the otherwise cheesy masses into a multitude of fine particles. Experiments in the laboratory of the author showed that when diluted cow's milk, to which a solution of cane-sugar, grape-sugar, barley-water, starch-water, or gelatin had been added, was treated with acid, the precipitated casein carried down with it from one-third to more than twice its weight of the added substance. Gelatin more especially must be used in very small quantity, since otherwise it entirely arrests the precipitation of the casein. One of the simplest and best of these attenuants is barley-water, added to one-third its volume of milk. It may be prepared by boiling two teaspoonfuls of pearl barley in a pint of water in an open saucepan until the bulk is reduced to two-thirds, and then straining. Instead of barley, oatmeal may be used, or gelatin. To prepare the latter put a piece of plate gelatin an inch square into a half-tumblerful of cold water, and let it stand for three hours; then turn the whole into a teacup, place this in a saucepan half full of water, and boil until the gelatin is dissolved. When cold this forms a jelly: two teaspoonfuls are sufficient to thicken a mixture of three ounces of milk and five of water.

Dextrinized Attenuants.—A gummy material like dextrin, or a gelatinous substance, or a saccharine body, or a finely-divided starch like that occurring in barley- or oatmeal-water, along with more or less glutinous extractive matter, is far better adapted to serve mechanically as an attenuant of the coagulated casein than farinaceous foods in their ordinary condition. Many different preparations are sold in which, by prior heating (dextrinizing) or by digestion with diastase, wheat and barley flours are modified to this end. By the action of heat at 300° to 400° the principal substance which is formed is dextrin, a body differing from starch by its being soluble and by having the physical characters of a gum. Diastase produces principally maltose along with dextrin. The flour selected for either treatment should be highly albuminous, made of wheat grown at certain seasons and of certain grades, and should be the best grade of that made by the roller process. Grouping together under the head of soluble carbohydrates the sucrose, dextrose, maltose, and dextrin originally present or made by treatment, the changes can be traced in the following table. The first column gives the composition of a wheat flour, the second the same after baking. The remaining columns exhibit similar products from other specimens of wheat flour, the process having been carried further in some of the dextrinized foods than in others:

	Wheat flour.	Same baked.	Blair's Wheat Food.	Imperial Granum.	Ridge's Food.	Schumacher's Food.
Water	9.02	7.78	9.85	5.49	9.23	6.26
Fat	1.01	0.41	1.	1.01	0.63	1.89
Starch	76.07	67.60	64.80	78.93	77.96	39.81
Soluble carbohydrates	5.66	14.29	13.69	3.56	5.19	36.57
Albuminoids . . .	7.47	. .	7.16	10.51	9.24	13.54
Gum, cellulose, etc.	undetermi'd	. .	2.94	0.56	. .	0.49
Ash	"	. .	1.06	1.16	0.60	1.44

By heating, the albuminous substances also become considerably more soluble in water. Wheat flour, which in its original condition yields a very considerable amount of crude gluten on washing, after baking leaves a much smaller quantity. For the same reason a baked wheat flour may be mistaken

for barley flour, which has a non-glutinous dough. Along with these analyses may be given that of Robinson's Patent Barley, which is flour prepared from ground pearl barley, and "A B C" cereal milk, which is made from wheat and barley meal:

	Robinson's Patent Barley.	"A. B. C." Cereal Milk.
Water	10.10	9.33
Fat	0.97	1.01
Starch	77.76	58.42
Soluble carbohydrates	4.11	20.00
Albuminoids	5.13	11.08
Gum, cellulose, etc.	1.33	1.16
Ash	1.93	

Flour-ball.—Much has been written on the use of "flour-ball" prepared by long-continued boiling of superior wheat flour tied up tightly in a bag. A sample thus prepared by Dr. J. Lewis Smith and analyzed at his request afforded the following results. It was boiled for five days, fifteen hours a day, or seventy-five hours in all, the bag being taken out of the water over night. The original flour was white; the boiled flour, after thorough drying and pulverizing, of a light-yellow color. Its taste was remarkably flat and insipid, the long-continued boiling dissolving out the fat, some of the soluble albuminoids, and mineral matters. It is possible that very different results might have been obtained from a flour of different character and boiled for a much shorter interval (Dr. Eustace Smith recommends but ten hours):

	Original Flour.	Same Boiled.
Water	9.546	10.55
Fat	0.766	none.
Starch	71.924	72.362
Soluble carbohydrates	5.120	5.178
Albuminoids	11.280	10.520
Gum, cellulose, etc.	0.835	1.028
Ash	0.506	0.42

Liebig's Foods.—In the preparation of the flour by means of diastase (Liebig's foods) equal parts of wheat flour and barley malt, a certain amount of wheat bran (added, it is said, for the sake of the adherent phosphates and nitrogenous matter), together with 1 per cent. of potassium bicarbonate, are mixed with sufficient water to make a thin paste. The mixture is allowed to stand at ordinary temperatures for several hours, and then heated to 150° until the conversion of the starch into maltose and dextrin is completed. It is then strained and the residue pressed and exhausted with warm water. The extract is evaporated in vacuum-pans at as low a temperature as consistent with rapidity of working, and then dried with stirring at a higher temperature, so as to be brought into pulverulent porous lumps. The author's latest examinations of samples of foods belonging to this class are as follows:

	Mellin's Food.	Horlick's Food.	Savory and Moore's.
Water	12.37	9.70	8.34
Fat	0.18	0.34	0.40
Albuminoids	10.07	10.43	9.63
Soluble carbohydrates	68.18	76.83	44.83
Starch			36.36
Gum, cellulose, etc.	5.45	0.50	0.44
Ash	3.75	2.20	0.89

The starch is absent when the process is complete, and such was the case with some of the samples tested; in other samples a considerable portion remained.

The preceding foods are ordinarily employed with milk, the mixture being made at time of feeding. Still another class remains in which the dextrinized or malted flour has already been evaporated with milk, and which is prepared with the aid of water only. They are of very different composition, as will be seen from the following table:

	Nestle's.	Anglo-Swiss.	Gerber's.	American-Swiss.	Franco-Swiss.	Wells & Richardson's Lactated Food.	Loeflund's Cream Emulsion.	Malted Milk.
Water	5.00	6.50	6.78	5.68	4.43	7.76	24.32	2.18
Fat	4.25	4.91	2.21	5.81	3.70	1.64	15.32	5.30
Albuminoids	11.00	10.26	9.56	10.54	13.00	11.85	8.23	15.83
Soluble carbohydrates	40.91	46.43	44.76	45.35	46.09	39.00	49.43	66.99
Starch	36.86	29.48	35.00	30.00	30.86	36.43	Undet.	5.57
Cellulose, gum, etc.	0.28	0.40	0.48	0.41	0.50	0.71	"	
Ash	1.70	2.02	1.21	1.21	1.42	2.61	2.60	3.13

In the preparation of these foods the flour is first made into a dough and baked. The resulting biscuit is then finely ground and mixed with various amounts of condensed milk and dried by a slow heat at a moderate temperature. This leaves a mixture in which the starch has been partly changed into dextrose, maltose, and dextrin; the albuminoids of the flour have undergone the partial decomposition spoken of in the case of the farinaceous foods; the casein has been dried into separate particles, and the lactalbumin has been coagulated. On the addition of water the saccharine and a small portion of the albuminoids dissolve; the main portion of the albuminoids, the casein, and the starch, are left undissolved.

In the actual preparation of farinaceous, Liebig's, and milk foods for use in the feeding-bottle, the adjustment of the relative proportions should be such as to afford a ratio between the fats, albuminoids, and saccharine materials as nearly the same as that in human milk as possible. By making the cow's milk the principal article of the mixture, and basing the approximation on such a ratio as will render the albuminoids not very different in their gross amount from that in woman's milk, foods of the following character may be obtained. Of course the constituents other than the albuminoids differ widely in their gross amounts, and what has been said before in relation to their relative values in nutrition must here be borne in mind also. Selecting one food of each class, Column I. represents a mixture of 3 parts of thoroughly dextrinized flour, 47 parts of cow's milk, and 50 parts of water; Column II. the same relative amounts of Mellin's food, milk, and water; and Column III. a mixture of 1 part of Nestle's food and 6 of water:

	I.	II.	III.
Fat	1.91	1.86	0.71
Soluble carbohydrates	3.17	4.11	6.82
Starch	1.94	. .	6.14
Albuminoids	2.27	1.89	1.83
Ash	0.36	0.43	0.28
Total solids	9.65	8.29	15.78
Water	90.35	91.71	84.22

EXERCISE AND MASSAGE.

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I. Exercise.

The wisdom of directing critical attention to the bodily exercises of children is coming to be better appreciated by physicians and teachers. It is not safe to assume the possession of inherent powers competent to spontaneously develop in all directions, and no argument is required to demonstrate the great importance of using all practicable means to bring about the fullest development of sound bodily and mental powers. Of yet greater importance is the need to husband and enlarge the vitality of those already handicapped by defective organization or depressing environment.

The normal states of the infant are feeding and sleeping. Little more is needed during the first year of life than comfortable, clean surroundings, fresh air, and appropriate food, supplemented by ample rest. The little one should be left largely alone, distinct harm resulting from over-curious notice. Absolute freedom should be allowed the limbs by avoiding confining garments.

In the second year it is a good plan to place the infant upon a soft covering on the floor and encourage all spontaneous movements. So soon as the child makes voluntary efforts at standing, reaching for objects, etc., supply harmless toys, especially such as can be kept chemically clean, as of rubber or metal. Let it exercise untrammelled the budding powers, that its muscular sense shall teach dimensions of external objects and its eye judgment of distances and colors.

The eye in the child soon becomes a perfected organ; and so, indeed, the digestive tract, with limitations, of course, as to capacity. Not so, however, the limbs and trunk, which have much to learn and large need for exercise. Wearied out with joyful, spontaneous movements, which quicken circulation and expand the lungs, and feasted with slow contemplation of surrounding objects, the child should have opportunity to lie down comfortably and sleep.

All childhood should be passed in a series of simple object-learning. Encouragement is very well, but no distinct teaching of any kind is needed until the motive powers are well established and a fair stock of intelligence has been acquired by unaided, slow mental assimilation; avoid fine-spun theories of childless philosophers and garrulous kinsfolk.

When fully able to make his way about the room or garden, the child should have full scope, so that his own experience may give him consciousness of his own capacities and limitations, enabling him to protect himself and yet secure and inspect the many coveted objects just out of reach. Thus, little by little, stores of information are acquired, a knowledge which is all his own, because come at through abundant slow contemplation in his own time and manner and by his own unaided faculties. These aptitudes, too, grow by what they feed on. Selection is thus exercised: eye, hand, and leg are brought to the fulness of their strength, and the highest human faculty, judgment, is soon or

late acquired. In mere bodily activities a healthy child may be trusted to do enough and not too much. If urged beyond its own choosing, the element of excitement comes in, always a confusing factor in measures or results. Soon impressions from inanimate and other objects will no longer satisfy. Then comes the period of childish games, when running, shouting, rolling about, give tone to muscle and prompt conduction from brain by nerve-paths to extremities. When in the course of progress a certain time comes, by common consent, wherein systematic teaching should be had, then must the bodily powers and parts receive closest scrutiny. No school system is adequate which does not consider the training of the body as of almost equal consequence with that of the mind. Among the more comfortable classes this may be supplied by the family physician, but is all too rarely well accomplished. When this is not done, as among those who use the public schools, a skilled medical supervisor should be provided who shall pass judgment upon every scholar. Thus will be brought to light heretofore unrecognized weaknesses and deformities, or in the needful repetitions of these examinations hurtful tendencies may be early recognized and checked. In the matter of the eye supervision is becoming pretty generally exercised, and much good already accomplished thereby. Of yet more importance, however, is the quest of weak hearts, unsymmetrical backs and limbs, narrow chests, and twisted pelves. Soon or late, calisthenic exercises, military drill, class singing, or some systematic form of body training will be a regular part of the day's instruction in most schools, with more of the open-air object-teaching by stream and field which is already used to supplement the didactic in many large schools and colleges.

Among the most important defects needing attention are spinal deformities. The commoner of these is lateral curvature, always a product of impaired vitality with lowered respiratory capacity. This, before exhibiting itself in the posterior view, frequently produces alteration in the plane of the shoulders, the direction of the ribs, and shape of the chest. Scoliosis is a disease of development, its origin lying in weakness of the muscles which support the spine and in evil postures long maintained, strains in one locality producing compensating curves in some and rotation in other parts. Girls are much more subject to this deformity than boys, partly because they are muscularly weaker, but more, perhaps, by reason of a deplorable physical indolence which custom encourages. Therefore enforced exercises, coupled always with periods of rest, are more needful for them than for boys. Many instances of spinal warping doubtless pass away unrecognized, owing to improved conditions occurring in the ordinary course of development; but they will be revealed if critically searched for. This observation is proven by reports from examinations made by experts in schools, orphan asylums, and the like; and if these sufferers be so circumstanced as to lack proper activities, or if hurtful influences supervene, or laborious occupation be assumed, these imperfections become accentuated or even worse ones may appear.

The remedy is to be found in varied muscular exercises taken at suitable times. The best are vigorous outdoor movements, games, leaping, running, climbing, and all sorts of hard play, the more varied the better. These, again, should, of course, be not unduly prolonged, especially for girls. Large scores at the skipping-rope and long match games at tennis, or even croquet, are prejudicial to female fibre. Indeed, the best forms of exercise for all children are those which speedily shift, being interspersed with ample periods of *rest*.

Special forms of physical training for the young can only be touched upon briefly. Active games are very useful for alert, energetic children. Systematic drills or sports authoritatively directed have wider scope; but the best results

are had when skilled direction is afforded, both as to time occupied and amount of force used, directly to the individual. The German class gymnastics of free movements and Gerätubungen, or exercises with apparatus, are valuable, provided not only definiteness is given to effort in kind and degree, but also the invaluable factor, *incentive*, is supplied.

The most practicable and safe measures for regulating bodily defects are to be found in the Swedish system of educational gymnastics. Here each movement is grounded on a sound physiological reason, so that special movements can be formulated to suit special needs, and can be changed with advantage, less or more or other, on the "day's order." They are safe, reliable, and very efficacious.

Direct injury to a child from over-exercise is rarely possible unless such excitement as ambition or fear over-impel; moreover, when manifested, there is every reason to suspect organic defect, which may be thus savingly revealed. The burden of over-exercise in children is most liable to be borne by the organs of circulation, and such mischief as arises is attributable to disturbance in the balance of power between the ability of the heart to supply blood to the tissues and the eliminative capacity of the lungs and skin.

The neuro-muscular mechanism is capable of enduring far more work than the circulatory activities will warrant. Profound fatigue, as from long exhaustive walks or runs, may reduce the child or youth to a helpless mass of ineptitude, and then, if the spur of fear be applied, almost as much again of energetic output can be expected. The results from such an extremity of exhaustion will probably be a fever from the strain on the nervous discharges and the retained products of metabolism, which will burn itself out in a few days at most. If there be an organic weakness, that will probably be accentuated.

The balance of nervous discharges may be so disturbed as to throw organic processes out of rhythm, temporarily or for longer time. Exercises of an exhaustive nature tend to produce the disturbances due to over-taxation of the organs of elimination. For example, heat-exhaustion is more liable to seize one who suffers from a long walk rather than a long ride. Emotion or excitement has most to do with producing over-work. The excited person, or one whose body has not learned to work economically under impulse, therefore makes a wasteful outlay of force, and exhaustion comes early, although it may not cause a cessation of work.

The phenomena of over-work may be divided (as by Lagrange) thus: 1. Local fatigue or temporary tire, the discomfort which arises in a limb after an excessive number of muscular movements or contractions, the limit of which varies greatly according to the character as well as condition of the individual. 2. Breathlessness, which is loss of balance between the eliminative power of the lungs and the capacity of these organs to take in oxygen promptly and sufficiently—index of respiratory need. The stages of this are—*first*, wholesome respiratory excitation, whence comes the *bienfaisance* which follows full respirations; *second*, the labored, tugging efforts to void the CO_2 and regain the balance of respiratory power: in this the vagi and heart-muscle play some part, but quite secondary to the auto-intoxication: and *third*, carbon-dioxide poisoning to the brain, dulled intelligence, cyanosis, vertigo, cerebral vomiting, etc. Breathlessness is a sort of index of aptitude, indicating better than muscular fatigue the capacity of the individual. 3. Stiffness of the muscles, chiefly from insufficient *dissimilation*, or voidance of effete matters, also from traumata to the nerve-fibrils and tendinous insertions, etc.

A boy, say of seven years, bears with great ease a large amount of running, interspersed with periods of rest ever so brief. This is largely due to the

admirable ease with which in the child the lungs adapt themselves to the needs of forced respiration, whence he gets rid of the excess of carbon-dioxide. This same boy cannot with impunity endure long-sustained, unremitting effort, because "dissimilation is much more rapid in the child than in the adult," and the products of nitrogenous waste—of uric acid especially—are longer in forming and not so readily voided. The accumulation of these in the blood may produce a febrile attack in a child, as of gout in an adult.

No absolute rule can be formulated by which the amount and degree of exertion suitable for each one can be recognized. This can only be determined by some knowledge of the individual's state or capacities. Much more harm comes of over-solicitude and limitations than from wholesome fatigue. Very excitable children can be over-tired readily, and some damage result, mostly of a temporary nature. The duty of the medical adviser is to estimate these powers and limitations and make them known to both parent and child.

II. Massage.

Massage, or the skilful kneading and rubbing of the soft tissues, is a remedial agent of recognized value. Originally, it was used as a luxurious accessory to the bath or toilet, but of a kind which produced substantial and desirable results, chiefly in the line of improved nutrition.

As a therapeutic agent massage has been by many writers, mostly ill-informed folk, absurdly lauded, and hence for a time fell into merited disrepute, but latterly, its place coming to be better defined and its effects more clearly known, it now enjoys a justly increasing popularity. Massage was early used mainly to remedy local defects, as exudations, infiltrations, and contractures. It was reserved for Dr. S. Weir Mitchell to direct the attention of the medical profession to the enormous value of general massage as a tonic and restorative. He makes use of it as the chief agent in "depriving rest of its evils;" and in this original application is now followed extensively by thoughtful physicians the world over.

The infant begins life as a passive agent, and excellent effects are wrought upon its growth by judicious rubbing, with or without oil. The writer, early impressed with the possibilities of massage in the new-born, initiated a series of observations on babies during an out-patient obstetric service, and obtained unexpectedly gratifying results. These were supplemented by the experience of several other men in the new-born and in selected cases of malnutrition. The mother or nurse was instructed carefully in the simpler technique of massage, and directed to rub the child with olive oil over its entire surface daily, and to increase gradually the time and force used. No other cleansing medium was needed as a rule, and dangers from bath-chill were thus averted. Improvement was almost invariably gratifying, and at times brilliant, even when no ailment existed, but was especially noted in those below par. The beneficial effect was first observed in the skin, which softened notably, becoming clarified and rosy-tinted; then fretfulness ceased and sleep came more amply, the bowel-action fell into normal sequences, and presently the muscles grew firm and strong.

In beginning a treatment by massage the subject must be put in a comfortable position in which all fatiguing muscular tension shall be eliminated fully, and this will take wise, gentle handling and several sittings to accomplish. The manipulator holds the part operated upon in a comfortable poise always, the subject not assisting at all; otherwise needless fatigue results. The movements should never be so sudden and jerky as to give pain, and

ere long the surfaces will become tolerant of what at first might cause discomfort. It should be constantly borne in mind by the manipulator that the surface nerves and blood-vessels being thus highly stimulated, heat is evolved, which loss is liable to be followed by chilling of the part if left exposed. Therefore, as each part is disposed of, it should be instantly wrapped up in woollen fabrics.

TECHNIQUE.—As there are many perfectly satisfactory means of accomplishing the same desired end, it is of primary importance to clearly know what that end shall be; next, to bear in mind the *tissues* handled, their character, position, and function. While a pretty fair knowledge of anatomy and physiology should be possessed by the manipulator, a little less of knowledge and the over-confidence which this begets, and more of humble-mindedness, are a priceless boon to the patient.

It is unnecessary here to elaborately describe the various manipulations, which are all reducible to four movements, and called by the Metzger school, curiously enough, by French names which signify stroking, rubbing, kneading, and tapping. These are distinguishable from one another partly through their peculiar character, and partly by means of the different ends they aim to attain.

Stroking (*effleurage*) is done from without toward the centres, exercising varying degrees of pressure, and its more prominent office is to expedite circulation in the blood and lymph-channels.

Rubbing (*friction*) is chiefly done in little circles over limited areas with considerable pressure, and is designed to promote backward unloadings of vessels, as in exudations and infiltrations, and to press the tissue-refuse along the lymph-canals.

Kneading (*pétrissage*) is done by pressing or rolling together—a sort of pinching, which should, however, include so large a mass and so gently as not to hurt at all. Thus, also, the muscles are pulled to and fro from their beds, the more so when they especially need this action, as in contracted states from faulty use or long disuse. The effect aimed at is much the same as in *friction*, the keynote being to make the upper tissues rub the lower ones and to stretch out and elasticize stiffened parts.

Tapping, or striking (*tapotment*), is done by graduated blows of the finger-tips or side-hand, and is a potent means of mechanical excitation. This is most used on the larger muscle-masses, and helps to reach the structure below. Along nerve-trunks tapping or a modification of this, a tremulo movement called "vibration," is claimed to be of value.

The amount of time needed for a séance of massage varies greatly. For local use five minutes to a quarter of an hour, for general tonic action half to three-quarters of an hour, will usually suffice for children. If too much time or force be used, exhaustion is liable to follow. It is imperative that a slow, progressive increase should be made the rule. A lubricant to the skin is rarely needed, and, if so, only at first, and should be some simple oil, as olive or cocoanut oil or a very nice quality of mineral oil. The last is liable to irritate; the first to smell badly and foul the clothing.

The direction of movement should be from the extremities toward the torso, beginning with toes or fingers and ending with the trunk. After a few weeks it is generally wise to supplement this by regulated active "movements."

The physiological effect of massage is manifested chiefly upon the circulation, promoting this not only within the tissues operated upon, but directly influencing the circulatory activities of the peripheral parts lying adjacent,

and, as Von Mosengeil says, acting both as a pressure and suction-pump simultaneously. By virtue of this power, too, nutrition, local and general, is strongly influenced by the expedition of cellular exchanges, which, in turn, depend on blood-supply and lymph-currents. Thus, too, atrophic states are checked and repaired. A peculiar power resides in stroking to remove the painfulness of fatigue and to restore tone and comfort to muscles tired temporarily or chronically wearied. This tire is both a vital and chemical effect, evidenced by faulty elimination of the products of metabolism, as carbon-dioxide, lactic acid, and the cadaveric alkaloids. As these are driven out by mechanical or other means, comfort and power return.

According to Dr. Louis Starr, massage may be employed with advantage in the following diseases of childhood:

(*a*) Chronic Gastro-intestinal Catarrh.—In this condition the skin is harsh, the muscle-tone is faulty, general nutrition is impaired, and there is a determination of blood from the surface toward the mucous membranes. To get the skin active, and in this way balance the circulation, is an important step in the re-establishment of normal digestion, secretion, and excretion, the essentials of perfect nutrition. To accomplish this a full, warm bath is administered every evening just before bed-time, the patient remaining in the water for five minutes. Then the surface is thoroughly dried, and half an ounce of olive oil is gently rubbed into the skin, the child enveloped in a light blanket, and put to bed. After a little time diaphoresis begins. So soon as the sweating is free the skin is again dried, and the night-dress put on in prepparation for sleep. Next morning, at some convenient time after breakfast, the child is subjected to twenty minutes' massage. The inunctions are continued until the skin becomes soft and active, and massage is employed daily until there is a decided improvement in the amount of flesh and general strength, a period generally of two or three weeks. Afterward "movements" every third day will be sufficient to complete the cure.

(*b*) Constipation.—Manipulation is a very efficient remedy in habitual constipation, and there are many cases that can be cured by it, combined with a properly regulated diet, without the use of drugs. Pétrissage of the colon is the best method, instructions being given to follow the natural course of the fæces through this portion of the gut; thus, beginning in the right iliac region, to proceed upward to the right hypochondrium, to cross over to the left hypochondrium, and then downward to the left iliac region. Five or ten minutes every morning, or every morning and evening in obstinate cases, constitute the proper duration and frequency of the applications. The pressure must be gentle, as delicate tissues are being dealt with.

(*c*) Colic.—Every experienced mother knows how often flatus, the cause of colicky pain, is expelled from the stomach or intestines by gently rubbing the abdomen with the hand. Any approach to scientific manipulation is much more efficient, and two or three minutes' effleurage may be resorted to, as the urgency of the symptoms requires, with the most satisfactory effect. In this connection it must be remembered, also, that rubbing of the feet to increase the circulation is an important aid in relieving colic.

(*d*) General Debility and Anæmia are much benefited by short, frequently-repeated courses of massage.

(*e*) Infantile Paralysis.—Here massage of the paralyzed muscles brings more blood into them, and maintains their nutrition until in favorable cases new cells in the cord take on the function of those which have been destroyed.

In essential paralysis the affected members are always cold, and the muscles contract feebly, if at all, under the influence of electricity. By systematic

massage an improvement takes place with more or less rapidity. The first indication of this is an increase in the temperature of the parts, and then a return of the electrical contractility of the muscles.

In recent cases the sittings should be of short duration and frequently repeated, five to ten minutes three or four times daily. As improvement advances the frequency may be reduced, and in chronic cases twice a day will be sufficient at any time; or once, if supplemented by "movements."

(*f*) CHOREA.—So far as this branch of the management of chorea is concerned, it requires to be aided by proper diet and rest in bed. On the onset of an acute attack the patient is put to bed, given a full supply of good food, and allowed to rest for two days without massage. At the end of this time the regular treatment is initiated. The plan, a slight modification of that recommended by Goodhart, is as follows:

The child—at seven years of age, for example—has at 5.30 A. M. half a pint of warm milk; 7 A. M., half a pint of milk and three slices of bread and butter (each slice an ounce in weight); 9.45 A. M., a teaspoonful of Merck's dry malt in a little milk; 10 A. M., massage for fifteen minutes, followed by half a pint of warm milk; 12.30 P. M., a teacupful of rice pudding, half a pint of milk, green vegetables, and mashed potatoes; 4.15 P. M., half a pint of warm milk, three slices of bread and butter, and a lightly boiled egg; 7 P. M., malt as before; 7.30 P. M., massage for fifteen minutes, followed by half a pint of milk. At the end of ten days or a fortnight the bread and butter is increased to four slices at 7 A. M. and 4.15 P. M.; a lean broiled chop is added to the midday meal, and an extra pint of milk is distributed over the twenty-four hours. After two or three weeks the patient may be allowed to sit up in bed, well supported by pillows, and may have a few toys to play with. It is a golden rule, however, never to hurry a patient with chorea out of bed. The muscular strength is more quickly recovered while at perfect rest, and too early exertion often causes a relapse.

(*g*) Other nervous diseases in which massage is employed with success are pseudo-hypertrophic paralysis, facial paralysis, neurasthenia and spinal irritability occurring in girls about the approach of puberty; that ill-defined and painful condition so often encountered in young subjects and known as "growing pains;" and, finally, affections of the heart and kidneys.

(*h*) Pleuritic effusions (serous), fibroid pleurisy, enlarged lymphatic glands, and stiffened rheumatic joints are all benefited by rubbing. In these special instances the manipulations are generally combined with the use of embrocations, though the curative effects cannot be attributed to the latter alone.

SEA-AIR AND SEA-BATHING IN CONVALESCENCE.

By W. M. POWELL, M. D.,
Atlantic City.

The difference between the air of an inland town and that of the sea-coast is that the latter is not only pure, but is saturated with sea-salts from the breaking of the waves upon the shore and the dashing of spray, which is carried toward the land by air-currents. If the wind is blowing from the sea, this characteristic saline odor may be noticed for some miles inland, but during a "land-breeze" it is hardly perceptible, even upon the beach. E. Freidick, in the *Southern California Practitioner*, quotes a large number of observers who have demonstrated the presence of sodium chloride in the air at the seaside, and shows that while there is naturally a small proportion of salt in this atmosphere, the greatest part of it is due to the diffusion of minute particles of sea-water. The proportion of salt is increased during strong winds, which blow the fine spray inland.

The air of the sea has a peculiar odor which is difficult to define, but which it is impossible to forget when once it has been inhaled. This odor, which is caused by the evaporation of the extractive matter contained in sea-water, is stronger when the waves dash upon rocks covered with sea-weed than when they break gently upon a sandy shore. It is also more perceptible during a storm than when the sea is calm.

Upon the border of the ocean the air is under greater pressure than in places of greater elevation, and consequently it contains more oxygen. The range of the barometer, the thermometer, and hygrometer is reduced to a minimum. These facts are only too often neglected in our estimates of the qualities of sea-air; they are, however, in a great measure responsible for the benefits derived by invalids during a residence at the sea-shore.

Ozone is one of the constituents of the atmosphere which is found in abundance on the sea and adjoining coast. Schönbein, its discoverer, believed it to be naturally formed out of atmospheric oxygen by the electrical discharges constantly taking place in the air. It is a most powerful oxidizing agent, so destructive to organic miasmata that its mere presence is a warrant of the absence of such noxious elements. It is more abundant by the sea than inland, and in windy than in calm weather. It is well known that the climate of any place where ozone is found in abundance must be healthy and exhilarating; hence we have at the sea-shore a pure air, containing oxygen in the form of ozone, besides finely divided sea-salts, as well as water which is rendered stimulating by the presence of the same salts. It most cases the breathing of this air has a marked invigorating effect, causing a great improvement in the appetite, promoting digestion and almost immediately producing a delightful exhilaration of the entire system. "No doubt can be entertained, in view of often-observed facts, that the effect of exposure to sunlight upon animal life is directly invigorating; and when with this is combined the constant inhalation of salt-air, and the daily application of salt water to the whole

surface of the body and limbs, it is easy to see why children should gain health and strength at the sea-shore."—*Packard.*

The temperature on or near the sea may certainly lay claim to greater uniformity than is obtained in localities remote from the coast. During the summer months the heated air of the land may be replaced by the cool breeze from the sea, while in winter the temperature of the coast-line is raised by the admixture of the warmer air from the sea with the colder air of the land. It is estimated that the Gulf Stream in this latitude during winter imparts to the air in contact with it a temperature of at least ten or fifteen degrees above that of the atmosphere of the earth, so that the ocean air in mixing with that of the land imparts to it an agreeable mildness which is unknown in the interior. Another favorable condition is found in the fact that the warmer air from the sea holds a large amount of invisible aqueous vapor in suspension, and as this commingles with the colder air of the land, it is condensed, gives out its latent heat, and becomes visible in the formation of clouds, especially at sundown. Thus that radiation of heat from the earth's surface into space which always takes place on clear nights is prevented. We can therefore safely assume that the mean temperature of the sea-coast is neither so high in the summer nor so low in the winter as that which prevails in the interior. These facts are well illustrated in the following table, prepared by Sergeant W. D. Blythe from the reports of the United States Signal Office, giving for five well-known localities the mean temperature for each month and the year, computed from November, 1879, to December, 1884, together with the average temperature for each of the four seasons:

	Winter.				Spring.				Summer.				Autumn.				Year.
	Dec.	Jan.	Feb.	Average.	Mar.	April.	May.	Average.	June.	July.	Aug.	Average.	Sept.	Oct.	Nov.	Average.	Amount.
Atlantic City, N. J. . .	36.8	32.4	35.7	35.0	38.6	46.7	57.8	47.7	66.9	72.6	71.6	70.4	68.8	58.5	44.5	57.3	52.5
Barnegat, N. J.	36.4	31.9	35.1	34.5	38.3	46.0	57.2	47.8	65.5	72.2	71.1	69.9	68.0	57.7	44.2	56.6	52.9
Boston, Mass.	31.4	26.4	30.1	29.3	33.9	43.6	55.3	44.3	65.8	69.9	68.8	68.2	63.5	51.7	40.9	53.4	48.4
New York City.	34.4	30.0	33.6	32.7	38.7	47.0	58.3	47.7	68.3	72.6	71.6	70.8	67.5	56.2	43.2	55.6	51.6
Philadelphia, Pa. . . .	36.1	31.7	37.1	35.0	40.2	49.9	62.6	50.9	71.5	75.1	73.7	76.8	69.3	57.7	44.6	57.2	54.1

As a sea-breeze prevails on a large majority of the days during the summer months, the average summer temperature is much lower on the sea-coast than farther inland. On some days the difference is greatly marked, and few of us have failed to experience the relief afforded by the first breath of sea-air after spending a day in the hot city.

It is self-evident that the pleasantest climatic conditions are those which present the most even temperature, with only a moderate amount of wind and rain. The tables on the following page, compiled from the same source, give some interesting statistics of rainfall, temperature and wind at various well-known stations of the Signal Office.

Touching the question of health, the national mortuary table offers important data. There we find that while such model cities of the interior as Rochester and Milwaukee, swept as they are by the cleansing winds of the great lakes, show a death-rate respectively of 23.39 and 24.52 per 1000; while Philadelphia, the healthiest, save London, of the world's great cities, shows 21.20; and while nearly thirty people to the thousand die annually in Charleston—the death-rate among the resident population of a sea-coast town like Atlantic City is 12.5. There are only two places in the United States—Ashtabula, Ohio, and Los Angeles, California—where the death-rate shows any approximation to this last percentage.

Annual Precipitation, in inches and hundredths, as recorded at the U. S. Weather Bureau Stations on or near the Atlantic Coast, 1882 to 1891, inclusive; also the Average Annual Precipitations, computed from observations covering periods of from three to twenty-one years.

Stations.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	Average amount.	
Asbury Park, N. J.	. . .	. . .	. . .	. . .	. . .	. . .	. . .	57.56	55.03	51.64	3 yrs.	53.44
Atlantic City, N. J.	55.29	44.64	53.70	38.45	44.80	37.76	44.10	38.43	33.04	43.04	18 "	42.81
Baltimore, Md.	42.11	40.52	43.88	46.04	53.11	43.59	43.53	42.35	46.96	54.21	16 "	43.11
Barnegat (closed).	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	8 "	50.20
Block Island, R. I.	57.65	39.69	63.05	39.37	54.50	44.55	29.18	32.80	31.51	39.03	11 "	44.49
Cape May closed).	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	10 "	46.70
Charleston, S. C.	57.01	51.35	60.22	67.93	65.94	44.61	49.46	52.25	47.84	45.90	16 "	58.92
Jacksonville, Fla	53.26	53.34	55.92	52.04	54.86	58.60	53.13	46.22	47.52	41.32	15 "	51.04
Narragansett Pier, R. I.	. . .	. . .	. . .	. . .	. . .	50.97	53.66	57.15	45.21	44.46	5 "	52.38
New Orleans, La.	50.18	69.85	60.01	64.18	54.83	64.97	45.15	48.45	47.17	38.62	23 "	51.78
Newport (closed)	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	6 "	59.98
New York City	46.61	38.83	55.34	42.32	46.73	46.63	52.95	58.68	52.30	51.44	21 "	45.76
Norfolk, Va.	57.67	54.30	45.05	43 25	34.33	47.74	56.64	70.72	50.22	50.63	21 "	52.21
Portland, Me	38.94	31.99	52.51	39.75	52.63	49.07	34.24	41.92	51.97	43.28	20 "	42.68
Sandy Hook	32.14	42.09	52.72	38.42	closed.	. . .	. . .	. . .	. . .	. . .	12 "	50.40
Washington, D. C.	46 79	45.71	49.96	44.84	58.17	45.38	61.33	41.59	52.95	51.22	21 "	45.06
Wilmington, N. C.	52.29	64.00	62.70	60.42	56.43	51.47	55.07	59.31	41.33	48.00	21 "	56.24

Monthly and Annual Mean Temperatures for 1889.

Stations.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Asbury Park, N. J.	36.2	28.5	40.4	49.1	62.5	69.6	71.5	70.8	66.6	51.9	45.6	42.1	52.9
Atlantic City, N. J.	37.6	29.5	38.8	48.6	59.0	66.2	71.8	69.3	64.4	51.8	47.0	43.6	52.3
New York City	37.6	28.0	41.5	51.6	62.0	70.4	73.5	71.5	65.8	52.0	46.0	41.4	53.5

Annual Movement of Wind, in miles, at U. S. Weather Bureau Stations on the Atlantic Coast for ten years, ending Dec. 31, 1891.

Stations.	1882.	1893.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	Avarage.
Atlantic City, N. J.	86.498	80.769	75.232	76.150	79.553	74.879	88.825	104.930	102.520	106.500	87.585
Barnegat, N. J.	117.564	128.939	125.081	124.061	closed	. . .	. . .	. . .	. . .	. .	(4 years) 123.911
Block Island, R. I.	132.595	130.575	127.478	122.608	125.698	132.975	147.384	148.944	. . .	. .	(8 years) 133.531
Cape May, N. J.	123.041	128.330	134.584	closed	. . .	. . .	. . .	. . .	. . .	. .	(3 years) 128.653
Sandy Hook, N. J	122.601	128.933	139.149	144.879	138.672	closed	. . .	. . .	. . .	. .	(5 years) 134.847

Diseases benefited by Sea-air.—It is often asked, What diseased conditions are benefited by a sojourn at the seaside? and, What, if any, are acted upon unfavorably? Dr. A. W. Bell, author of *Climatology and Mineral Waters of the United States*, says that, considering the purity of the vapor and perfect solubility of the salt, it is difficult to conceive of any possible state of the human system under which the inhalation of such air would be detrimental. I fully agree with this author, and believe that sea-air is preferable to any other during a tedious convalescence. I know of no place where children improve more quickly than at the sea-shore. I have studied this subject closely since 1883, when I was resident physician at the Children's Sea-shore House at Atlantic City, New Jersey. Since that time I have been connected with the same institution, where upward of seven hundred children, both convalescents from various acute (non-contagious) diseases and those affected with chronic ailments and strumous manifestations, are admitted yearly during the summer months. No one without experience can realize the benefit obtained by these little suffers, who remain at the Home for a fortnight to several weeks, according to the gravity of their cases. Here are sent, chiefly from Philadelphia, desperate cases of entero-colitis, patients almost completely prostrated by the heat, and other moribunds. Yet nearly all recover through the influence of the sea-air and

clean, healthful surroundings, with little or no aid from medicine. During the summer of 1892, in the latter part of July and the first week in August, the heat in Philadelphia and vicinity was intense. At this time I had more cases of severe entero-colitis than for several years, but they all recovered rapidly, save one, a child sixteen months old, who died four hours after its arrival at the coast. At the Children's Seashore House, where my friend Dr. W. H. Bennett was in charge, the cases were more severe than usual, but all terminated favorably.

It is an unusual circumstance for entero-colitis to develop at the sea-shore, and most of the cases seen there are brought from the neighboring cities or interior. Simple diarrhœa from indigestion, teething, etc. of course occurs.

Convalescents from scarlatina, measles, and the eruptive fevers generally do well by the sea.

The subacute nasal and pharyngeal catarrhs that we so often meet with in the spring as the results of repeated winter colds, which are usually so obstinate, invariably do well at the shore, where a complete cure is usually effected in a few days. Even cases of acute bronchitis seem to recover much more rapidly, and chronic forms are much improved. My experience with phthisis in children at the sea-shore has been limited: I have only seen a few cases, and they were far advanced. These children seemed to do well for the first week; the appetite improved, and sleep was more refreshing, although the cough remained about the same. After this they remained at a standstill, the improvement in appetite not being maintained and rest becoming disturbed again. These cases improved for the first few days when taken home, but fell back rapidly.

Asthmatic patients are frequently sent to the sea-shore, with, as a rule, most favorable results. Doubtless a long stay is beneficial to all such cases, especially those associated with chronic bronchitis. Patients arriving during a paroxysm nearly always experience an immediate relief, especially in cases of hay asthma; but should the attack orginate at the sea-coast, removal to the city may in turn prove beneficial. Hyde Salter says: "I think it is a law, without an exception, that nervous affections are less prone to occur in proportion to the general bodily vigor, and what, for want of a more definite term, we must call the *tone* of the nervous system. Anything, therefore, that invigorates renders asthmatics less prone to their attacks. In this way sea-bathing is often of great service to asthmatics. By raising the standard of the general health it tends to prevent those humoral derangements which are often the exciting cause of asthma."

Cases of a strumous origin invariably do well by the sea: the appetite improves, the color returns to their cheeks, and they gain in flesh. Russel, who was the first to appreciate all the benefits derivable from the salt air, always had the hair of strumous children cut close, and exposed them freely to the cool sea-air with the neck uncovered; and he sent them back to their homes with their limbs strengthened and carrying in their countenances the evidence of the restorative powers of his remedy. When the strumous diathesis has further advanced, the effect of sea-air, although still of great utility, is much slower. There are many cases of cure, even when the glands of the neck have been greatly swollen, under the influence of two or three seasons passed by the sea. Roccas tells us that such a deeply ingrained constitutional disease as scrofula cannot be eradicated without a prolonged stay in a marine atmosphere. When the glands are ulcerated, Whitt many years ago recommended fomentations with sea-water and poultices made with it. It is supposed to facilitate the resolution of the swollen glands, even when they have become very

large and have existed for a long time. The following case, reported by Robert of Marseilles, fully confirms these assertions: "A lady coming from the interior of France brought to me her son, about fifteen years of age. The youth was enfeebled to the last degree, having been ill ever since he was nine years old. During all this time he had labored under scrofula of the neck, which was entirely surrounded with cicatrices of old ulcers. At the time I saw him the right elbow and one of the feet were affected; the elbow-joint was not diseased interiorly, but the ligaments which surrounded it were; and there were fistulous openings which had persisted for a length of time. As regards the foot, it was puffy and much enlarged, and he could scarcely bear it to be placed upon the ground: abscesses had formed several times, which had cicatrized, but there was another now threatening to open on one side of it. The most alarming feature of the case, however, was the terribly low state of the patient's constitution. His spirits were dejected; his face had the look of one prematurely old; his skin was dry and flabby; and his limbs almost entirely denuded of their flesh. Moreover, he was tormented with an almost continual diarrhœa. I advised the mother to establish her son upon the sea-coast, to make him pass the whole day upon the beach, and to make him use the sea-baths. Under this influence his general health began to improve, and then the swellings of the elbow and the thickening of the foot began to subside. Afterward I recommended that he should bathe daily, and that he should learn to swim. He fulfilled my orders so literally that he passed almost the whole of the latter part of the summer in the water. Always on the beach, he could find no other amusement so pleasant as that he derived from swimming. In a marvellously short time, considering the amount of disease, the youth was quite cured, and became what he still remains—a strong, healthy, and vigorous man."

Rickets is another common disease of childhood in which the benefits of residence by the sea are marked. The influence of sea-air upon this malady seems to exert a marvellous amount of good, and West, in recommendation of it, says that "even where marked deformity has already taken place amendment will be sure to follow." I fully agree with this authority, but will state that my experience in the past two years with this affection has been limited, as the stay of my patients during the summer months is hardly sufficient to show improvement if the disease is far advanced. But I do believe a prolonged stay by the sea, say a year or more, will bring about a complete cure.

Children suffering from Pott's disease, hip-joint disease, and arthritis of the knee all do well, gaining in flesh and improving in appetite without medical treatment.

Rheumatic cases, especially when chronic, do well by the sea-coast, and I know of no better treatment for this disease than warm sea-bathing. Fortunately for this class of patients, most prominent sea-coast resorts now can offer all facilities for warm sea-baths. These establishments are fitted with every convenience, including a lounging-room or "sun parlor," where one may take a nap after the bath. In cases of rheumatism the best results will be obtained from baths given on alternate days, followed by thorough friction of the body by a masseur or an intelligent nurse.

Cases of chorea during convalescence improve rapidly at the sea-shore. Although many writers highly recommend sea-bathing in this disease, I do not agree with them. Indeed, in one case, almost well, I am sure a relapse was occasioned by fright caused by a wave striking the child. Warm sea-baths, followed by a gentle massage, are preferable.

Sea-air has a very grateful influence in inducing sleep. Often sick children brought to the sea-coast sleep the first night better than for many nights before. It will be found that many children who are not ill after a few days' stay will complain of drowsiness and willingly take their afternoon nap.

The obstinate bronchitis which so often remains for an indefinite time after whooping cough is frequently cured by a few weeks' stay at the shore. In the paroxysmal stage of the disease, while the coughing spells are no less violent than elsewhere, children do not seem to lose flesh and color, no doubt because their appetite is kept up by the bracing effect of the clear atmosphere, and they are kept in the open air more than they would be in a city home.

Cases of infantile paralysis make a slow but steady improvement during a long stay by the sea. Most diseases of the skin and the inflammatory diseases of the eye are not improved by sea-air, unless these troubles have a strumous origin, in which case a long stay, by improving the general health, will indirectly improve the local condition.

Sea-bathing.—It is a popular belief that sea-bathing is both strengthening and hardening; and there is but little doubt that this opinion is well founded. It does not follow, however, that it should be practised by all without medical advice. Many hold that a plunge into water which is of lower temperature than air protects the system against attacks of catarrh and chill, and renders it indifferent to sudden climatic changes, whilst a few contend that perfect immunity from colds may be ensured by continuing the morning plunge throughout the year. We may say, without doubt, that sea-bathing, more than any other agent known, renders the body less sensitive to the influence of cold and to the injurious effects of prolonged exposure; but this, of course, is due to its invigorating and strengthening properties alone, and not to the element of temperature.

It is a remarkable fact that many persons who cannot profitably bathe in fresh water can do so in the sea; and the explanation doubtless is that the abstraction of caloric from the body in salt water is less than in fresh, by reason of its greater density. Probably, also, the saline ingredients have a more stimulating effect upon the skin and induce a more energetic reaction.

The most important characteristic of sea-water is its saline composition, and it is impossible to over-estimate the influence of the sea-salts in marine meteorology. It has been estimated that the average quantity of saline matter in sea-water is 3 per cent., consisting of chloride of sodium, sulphate of magnesium, sulphate of sodium, also muriate of magnesium and lime, with salts of iodine and bromine. Many, however, estimate the saline ingredients at 4 per cent. The above constituents are uniform as to presence, but are unequal in quantity in various parts of the world, so that in the Baltic a pint of water contains nearly forty grains of salt; on the coast of Great Britain it contains more than half an ounce; in the Mediterranean, much more; and in some ports south of the equator the quantity amounts to more than two ounces. It is in consequence of its saline character that sea-water does not evaporate from the skin so readily as fresh water. Even when the body is carefully dried particles of saline matter remain adherent, and find their way into the pores of the skin —as may be proved by the application of the tongue to the surface—and keep up a tingling glow long after the bath is over. We all know that persons when soaked to the skin by salt water do not take cold as easily as when caught in a shower of rain. This is explained by the fact that the pungent action of the sea-salts so stimulates the cutaneous circulation as to enable it to resist the depressing effects of the cold produced by the evaporation of the fluid portion. Sea-bathing, besides having all the beneficial effects of an ordi-

nary cold bath, has others peculiar to itself. The contact of the salt water and of the salt which adheres after the water left by the bath has evaporated stimulates the skin, increasing the circulation and exciting the sudoriferous glands. The beating of the waves against the surface of the body affords a passive exercise, with some of the advantages of massage; while to the more robust a healthful exhilaration and delightful active exercise are furnished by the plunge through the waves and the vigorous movements constantly required while in the surf.

At the resorts in the neighborhood of New York and Philadelphia the sea-bathing season is usually considered to be between the first day of June and the last day of September, as in this interval the temperature of the water ranges higher than at any other season.

The best time for taking a sea-bath is just before high tide. At that time the water has been somewhat warmed by passing over the hot sand. Moreover, the bathing is safer, from the fact that the tide still coming in would tend to wash the bather to the shore if he should lose his foothold, and, as the water covers a portion of the beach which was exposed to view a few hours before, there is less risk from dangerous holes and quicksands. But at most sea-shore resorts it has been found more convenient to bathe at the same hour each day—namely, at about 11 A. M., or two or three hours after breakfast, when the morning meal is digested and the system is beginning to feel the effects of the conversion of food into force, and is therefore better prepared to withstand the shock of the cold plunge. It is unwise, however, to bathe within two hours after any meal: whilst digestion is proceeding more blood is attracted to the digestive organs, in order that the process may be efficiently performed. But if we divert a portion of the blood to the surface of the body by the action of the cold bath, digestion is suddenly interrupted, assimilation checked, and congestive headache, cramps in the stomach, etc. are caused. In order to answer several of the questions which naturally arise, it is necessary to describe the phenomena, which are as follows: On entering the water there is a shock, accompanied by a sensation of chilliness and shivering; there is a respiratory embarrassment and a feeling of fulness in the head. Next follows a reaction, in which all these symptoms are relieved, and there is an agreeable sensation of warmth. If the bath is unduly prolonged, there follows another sensation of chilliness: the teeth chatter, the fingers and lips become blue, the respiration irregular and rapid, and the pulse weak and small. In the sea-bath each wave reproduces in a less degree the first shock, and at the same time hastens the development of the second chill. From the above description it would appear that the proper duration of the bath is a period short of the second chill, and the length of this period must depend upon the temperature of the water, the force of the waves, the strength of the patient, and a number of other circumstances.

I do not consider it wise to allow children to remain in the water over five minutes, and then they should be at once taken to their bath-house and not allowed to play on the beach in their wet bathing-suits. Before entering the water their heads should be wet, and they should be taken cautiously to the first line of breakers, where, in a stooping posture, the waves may wash over them. If children are afraid of the water, they should not be forced. The proper way is to accustom them gradually to the sea. Have them dressed in their bathing-clothes and allow them to play on the beach, when they will of their own accord go to the water's edge and gradually find their way in. Many children do not dread the water, and they may do much in allaying the fears of the more timid. I think three or four sea-baths a week quite sufficient

for even the strongest child. A thorough rubbing down should always be given, and the child quickly dressed, and allowed to resume its play in a sunny spot unexposed to the wind. There is no advantage in taking an infant (under two years) into the sea, and the practice as usually carried out seems almost inhuman: for these the heated salt-water bath is an excellent substitute.

The Management of Children at the Sea-shore.—At all times of the year the sea-shore is most beneficial to sick children, but it has only been a comparatively few years since the practice of going to the sea-side resorts during the winter and spring months came in vogue; previously, the three summer months were the only ones considered advisable to spend by the sea. At the present time it is deemed almost as necessary to take a child convalescing from an illness to the sea-shore in the winter and spring months as in summer.

In selecting a place of residence by the sea it is well to be near the surf. Houses situated at a distance from the beach are never as cool as those close to it. Therefore, in taking a sick child to the shore it is always advisable, especially during the summer months, to select a house in close proximity to the sea. Here the exhilarating breeze comes uncontaminated from the ocean.

The clothing of the child during its stay at the sea-shore should be slightly heavier than that worn in the city or country; hence it is always better to use woollen under-garments, light and loose in texture. Long stockings should invariably be worn, even in the warmest weather, as toward evening the air becomes several degrees cooler, and, if the breeze is blowing from the sea, at times almost cold.

Little change need be made in the food of children during their stay. The advantages, claimed by some authors, of a largely marine diet have probably been over-estimated, and much blame has been attached by others to fish, oysters, etc. for the frequent disorders of the digestive apparatus from which adults suffer at the sea-shore. From my own experience, however, the acute attacks of indigestion that we occasionally see are usually brought about by the elaborate menu which is found at our largest hotels, in contrast to the plainer home table which most are accustomed to. On arriving at the sea-shore the appetite is naturally sharpened by the change of air, and over-eating is the result.

Much thought should be given to the necessity of exercise. Children seldom need much urging, but the want of it among adults probably interferes with many of the benefits which otherwise would be gained.

For very young children, next to the walk in the nurse's arms, the drive upon the beach should be recommended. The perfect evenness of the surface renders it possible to take a very ill child into the open air frequently with the greatest benefit. One of the best forms of exercise for sick children is playing in the warm, dry sand. A spot should be selected where the sun does not beat too strongly, but which is at the same time perfectly dry. It is, as we all know, an unceasing source of amusement to children, and the harmless character of their little falls and tumbles during play often encourages them to efforts which they would not otherwise attempt.

PART I.

INJURIES INCIDENT TO BIRTH AND DISEASES OF THE NEW-BORN.

By EDWARD P. DAVIS, A. M., M. D.,

Philadelphia.

The mortality of the first year of life is variously estimated. Bernheim, from an extensive series of statistics, places it at $37\frac{35}{100}$ per cent. of all children born. Winckel states that 10 per cent. of children born perish before the eleventh day of life; of these, $\frac{7}{10}$ per cent. perish during labor itself, $3\frac{3}{10}$ per cent. die as a consequence of some injury received during labor, while $2\frac{2}{10}$ per cent. perish from diseases contracted at or after birth. We shall first consider morbidity and mortality among children arising from injuries received at birth.

Caput Succedaneum.

The most frequent lesion sustained by the fœtus during delivery is the formation of a tumor upon the head, usually known as caput succedaneum: this is commonly recognized after delivery as a somewhat boggy tumor, formed by infiltration of the scalp and fascia over the cranium, and usually situated upon the parietal bone opposite to that which came most in contact with the bony pelvis of the mother. The mechanism of its production is commonly thought to be as follows: In a normal presentation and position, the back of the child being to the left side of the mother's pelvis, and the vertex occupying the left anterior half of the pelvis, during the stage of expulsion the left half of the vertex of the child's skull receives the greater portion of the impact of force during descent and rotation. The continued pressure upon this portion of the fœtal skull temporarily checks the free circulation of blood and lymph through the tissues of the scalp and fascia. There remains upon the opposite half of the vertex a portion of the head less pressed upon by the bony pelvis; here, naturally, the blood and lymph of the scalp-tissues are prevented from circulating through the left side of the fœtal head by pressure, and accumulate and distend the tissues of the right half of the vertex. The result is a tumor upon the side of the fœtal head opposite that which actually engaged during the first stage of labor. The position which the child's head occupied in the mother's pelvis may then be reasonably inferred from the location of the caput succedaneum; thus in the usual labor this tumor occurs in the right parietal region of the head. Should the child occupy a second position, its back to the right of the mother, its vertex situated in the right ante-

rior half of her pelvis, the caput succedaneum can be found upon the left parietal portion of the fœtal head. Caput succedaneum is usually of no practical importance, as it disappears in a few days after labor. The infiltrated condition of its tissues, however, forms an excellent field for the growth of infecting bacteria. Should the mother's birth-canal be in a septic condition during labor, or should, through the carelessness of the nurse in washing the child, some injury occur to the tumor, the entrance of septic infection results in inflammation, and, in rare cases, in abscess of the scalp. The caput succedaneum is larger the longer the labor lasts, is usually of a bluish-red color, and does not distinctly fluctuate or pit upon pressure.

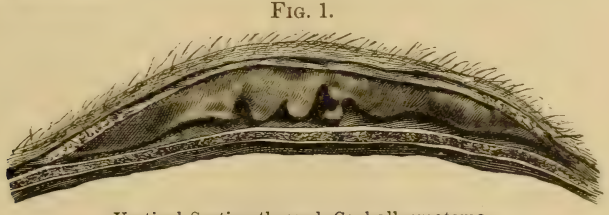
Occasionally the tumor embraces both parietal bones: this may be caused by long delay in the expulsion of the child, the head remaining for some time in the external genitals of the mother. Upon post-mortem examination extravasations of blood varying in size may be found in the vicinity of the tumor, and do not indicate criminal violence after birth. Two of these tumors may be found, a primary and secondary: the first is formed in the usual manner; the second is produced while the head is upon the pelvic floor and after anterior rotation has occurred. If delivery then be delayed, a secondary tumor will form, and may be distinguished from the first by its situation in the median line. In shoulder presentations the tumor is found upon the shoulder which presents.

So far as the treatment is concerned, Bouchut suggests the application of a solution of ammonium chloride, a solution of camphor, or an alcoholic mixture containing camphor. If this does not secure the disappearance of the tumor, he would aspirate it. Winckel and other obstetric authorities incise the tumor if it persists beyond the sixth or eighth day, and make pressure upon the parts with salicylated cotton. If abscess forms, incision and irrigation with a ½ per cent. solution of creolin are indicated.

Cephalhæmatoma.

By cephalhæmatoma Naegele, who first described it, designated a blood-tumor on the fœtal head, called *true* cephalhæmatoma when beneath the periosteum of the skull, and *false* cephalhæmatoma when beneath the aponeurosis of the scalp. Virchow explains the formation of cephalhæmatoma by referring to the way in which the pericranium grows—namely, by proliferation of inner layers of the periosteum. If, then, the pericranium is separated from the cranium by the extravasation of blood, the bone-producing layers of the periosteum are still formed, but are prevented by the blood-clot from uniting with that portion of the bone for which they were intended. They join, however, to the bone at the border of the extravasated clot, where the bone is still attached.

Fig. 1.



Vertical Section through Cephalhæmatoma.

Much discussion has arisen as to the method of formation of cephalhæmatoma. Some ascribe its presence to traumatism only, while others seek an

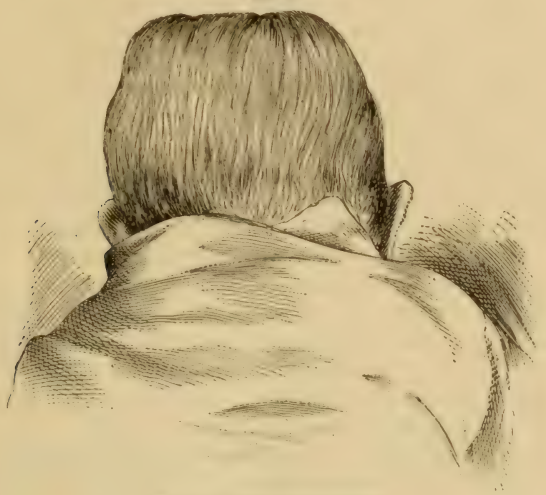
explanation in a pre-existing condition of the infant's tissues. It is to be differentiated from caput succedaneum by several important distinctions. The latter arises during birth, is born with the child, appears upon that portion of the head turned during labor toward the excavation of the pelvis, is more prominent after difficult labors, has an ill-defined border, frequently crosses sutures, is discolored in appearance, and doughy upon manipulation, and tends to disappear rapidly after delivery. On the contrary, cephalhæmatoma does not occur, as a rule, after difficult labor, appears usually upon that parietal bone which did not present in the pelvic excavation, has a sharply-defined border, does not extend across sutures, does not discolor the scalp above the tumor, and usually gives the sensation of fluctuation in the centre of the mass. Cephalhæmatoma also tends to increase steadily in size for some time after labor.

With such radical differences the pathology of these tumors must differ widely. That of caput succedaneum has been already given. In studying the pathology of cephalhæmatoma we have been struck by the fact that instances under our observation have been, as a rule, in ill-nourished children born without especially difficult labor. In the wards of the Philadelphia Hospital we have frequently observed these cases in children born of ill-nourished mothers and poorly nourished at the time of birth. This leads us to believe that a pre-existing malnutrition lies at the basis of these tumors; thus, cases are reported where, in addition to the cephalhæmatoma, a profoundly anæmic condition of various organs of the child's body was present. In no case does this tumor occur as an extravasation of blood beneath the internal periosteum of the skull; but extravasations of blood within the cranial cavity are also described under the title of "intracranial cephalhæmatoma." Partridge describes two cases in which coagulated blood was found beneath the dura mater. No injury to the bones of the cranium existed in these cases, the brain-substance was softened, and the blood found beneath the membranes and at the base of the brain seemed to have been extravasated from the sinuses and from the laceration of minute blood-vessels. One of these children died very shortly after labor; the other survived for several days. We recall a similar case where delivery was easily effected by the forceps; the child perished, however, in thirty-six hours after birth, and upon post-mortem examination blood was found extravasated beneath the membranes, while the underlying cerebral matter was softened. Here also no injury to the bones, membranes, or sinuses could be detected.

Cephalhæmatoma is more frequently found in males than females, according to Burchard, in the proportion of more than three to one. The tumor is usually found upon the right side of the head. The children of primiparæ are most liable to this complication in the proportion of three to one. As a rule, cephalhæmatoma does not pulsate, although isolated cases are reported in which indistinct pulsation was observed. While fluctuation is usually present, it may be very obscure. This results from the presence of coagulated blood, as well as the breaking down of the clot in the centre of the tumor. It is observed that if the tumor be opened soon after formation, bright-red blood escapes; later the blood resembles the fluid found after old extravasation. The deposition of bony material on the under surface of the periosteum occasions a crackling sensation when the tumor is palpated. The fluid escapes irregularly from beneath the tumor; sensitiveness is very rarely a prominent feature. The bony ring surrounding the tumor forms gradually; thus Bouchut observed a case before birth in which no ring was present. Semmelweis is said to have seen cephalhæmatoma in a child delivered by Cæsarean section.

Several tumors may develop in the same individual; thus we recall a case under observation in the Philadelphia Hospital in which double cephalhæmatoma appeared on the head of a male child born after a normal labor. Triple cephalhæmatoma has been observed by Oui after a precipitate birth in which

Fig. 2.



Double Cephalhæmatoma.

the infant fell to the ground, the cord rupturing three or four centimetres from the umbilicus. Upon examination a tumor was found upon each parietal bone, and one upon the occipital. The tumors were treated by incision and evacuation under careful antiseptic precautions, and uninterrupted recovery ensued.

The occurrence of cephalhæmatoma is readily understood when the loose attachment of the pericranium to the bone is remembered; Valleix found that in almost all infants ecchymosis between the pericranium and the skull is present after labor. It requires, then, but a constitutional liability to ecchymosis by reason of malnutrition to readily account for the occurrence of such tumors. Cephalhæmatoma, again, may develop after birth as a surgical injury, as instanced in cases described by Treves and Nélaton, as also in a remarkable case in a bleeder reported by St. Germain.

Cephalhæmatoma may be also produced by injudicious pressure exercised during the child's toilette. Hüter observed double cephalhæmatoma occurring on the fifth day after birth, and caused by the carelessness of a midwife, who, in washing the child, rubbed its head with undue force. The tumors persisted as long as the individual had charge of the child, but disappeared soon after she was discharged.

No one cause can be invariably assigned for the production of cephalhæmatoma: the size of the mother's pelvis seems to exercise but little effect, for Merttens in 21 cases found 6 in which the pelvis was normal, and only 5 in which slight pelvic contraction was present. In these cases the contraction was not of such nature as to interfere with labor. That the pressure of the pelvis has sometimes nothing to do with these cases is shown by Spiegelberg's observation of a case of premature birth at six months, in which the child perished before the rupture of the membranes; he was able to examine the head *in utero*, and detected the tumors before the expulsion of the child. He considered the tumors caused by interference with the oxygenation of the

fœtal blood, and oftentimes by premature efforts at respiration. Merttens reports a similar case in which he diagnosticated this complication before delivery. The fœtus in this latter instance had a congenital hernia of the diaphragm, and hæmatomata were found in other portions of the body.

The diagnosis of cephalhæmatoma in distinction from caput succedaneum has already been stated. Hernia cerebri may be present, but occurs usually in the occipital region and in the line of sutures. Pressure upon the hernia produces symptoms of positive disturbance of the nervous system.

Aneurism presents a pulsating tumor of darker color, which neither has the appearance nor affords the history of cephalhæmatoma. The effort to class this affection among the hydrocephali is scarcely successful in the light of our present knowledge of both. Blood-tumors found in the occipital region in the dead fœtus are often caused by difficult labor, and are dark in color from the decomposition of effused blood. In encephalocele direct examination of the head by palpation will enable the physician to make the diagnosis. Tumors in living children, the result of direct violence, are usually painful on pressure and lack the sharp outline of cephalhæmatoma. Occasionally, in advanced rachitis, where craniotabes is present, soft pieces of bone in the skull may simulate a blood-tumor when palpation is made through the scalp.

The usual plan of treatment consists in making gentle pressure by a pad of antiseptic cotton conveniently held in place by a night-cap. Occasionally lotions containing dilute alcohol or some acetous preparation are employed, but there is no evidence of their positive value. It must be remembered that the tumor, as a rule, will have reached its largest size six or eight days after the birth of the child. Unless hæmorrhage be excessive and the tumor becomes rapidly very large, it may be let alone for the first ten days of the child's life. Should infection occur and inflammation supervene, it must be freely opened at once, emptied of its contents, and the sac thoroughly disinfected, while continuous but gentle pressure is made by an antiseptic dressing. If no complication occurs, at the end of the first eight or ten days of the child's life the scalp over the tumor should be shaved, the surface thoroughly disinfected, preferably with boric acid, and the tumor punctured with a bistoury or large trocar. After evacuating the fluid contents pressure by an antiseptic dressing is indicated. Some prefer free incision in place of simple puncture. We have met with a case in which puncture and evacuation were followed by reaccumulation of fluid, and in which it was finally necessary to open the tumor freely, empty it, and pack it with iodoform gauze, the gauze having to be renewed several times before adhesion between the bleeding surfaces took place. Occasionally the loss of blood in these cases is considerable; as a rule, however, hæmorrhage is not a serious complication.

The susceptibility of infants to poisoning by antiseptics should be remembered in treating cephalhæmatoma. Mercurial and carbolic solutions may be preferably replaced by solutions of thymol, 1:1000, or saturated solutions of boric acid. Iodoform gauze may be employed without hesitation as tampon material.

Hæmatoma of the Sterno-Cleido-Mastoid Muscle.

A peculiar induration is frequently observed in the sterno-mastoid muscle of new-born children, regarding which different beliefs have been held. Anatomical study of the subject shows that the lesion is an intramuscular fibrosis, caused by direct violence to the neck of the child, usually occurring at delivery. Most of these cases result from delivery in breech presentation; the

forceps causes some; and, rarely, the lesion follows spontaneous birth. Schmidt reports the case of a child, seven days old, delivered by the breech, in which the right sterno-mastoid was shortened, and the right half of the face smaller and flatter than the left. The report of a post-mortem examination upon a case pointing to a possible intra-uterine origin of this condition is made by Heusinger. The head was directed toward the left, the right sterno-mastoid muscle was 9 cm. long, the left only 6½, and was a soft, white, tendinous substance. In 23,293 children examined at birth at the Paris Maternité, Guyon found 132 cases of monstrosity, but no case of torticollis, which militates against the congenital occurrence of hæmatoma of the sterno-mastoid. In 64 post-mortem examinations Ruge found 13 cases of this complication. In a recent valuable paper Spencer describes 15 cases found in 300 autopsies; his researches show that both sexes and the muscles of both sides of the neck are equally affected. Small, prematurely-born children are especially liable to this injury. Breech or footling presentation was observed in 10 of the 15. The forceps had been employed in 2 cases, while in 2 no instrumental aid was employed: in 2 of the bodies examined both muscles were affected. Spencer notes but two cases of contracted pelvis; one of his cases was that of triplets, complicated by placenta prævia centralis, with extraction through perforation in the placenta. His microscopic sections show clearly rupture of muscular fibre, with extensive effusion of blood. It has been shown by Witzel that, as a consequence of this complication, contracting fibrous bands may form, giving rise to permanent wry neck. Jacobi believes that the forceps is frequently the effective agent in producing this injury to the fœtus.

Hæmorrhage in the New-born.

A considerable number of cases of fœtal death occurring within the first forty-eight hours after labor are preceded by obscure symptoms which render an exact diagnosis difficult or impossible. The intelligent study of such cases by post-mortem examinations shows us that hæmorrhage is usually the cause of the fatal issue. As in the adult, hæmorrhage may depend upon an alteration in the condition of the blood itself, and also upon direct mechanical injuries which result in its escape from the vessels. In the first category of cases it has long been a familiar observation that syphilitic children, stillborn, show extensive disintegration of blood, with extravasation of blood-serum from the serous surfaces of the body. Children dying from acute infections on the part of the mother, and stillborn or perishing soon after, often display such a tendency to hæmorrhage; thus, small-pox, typhus, typhoid, scarlatina, and, as a rule, the acute infections as a class, predispose to the occurrence of hæmorrhage. There is also direct proof from bacteriological examination that the fœtus *in utero* may be infected by various micrococci, and that this infection may result in hæmorrhage and death at labor or very soon afterward. The occurrence of multiple punctate hæmorrhages accompanying umbilical sepsis is a not infrequent illustration of this form of hæmorrhage. In the recent literature of the subject Tavel and Quervian report a case of multiple hæmorrhage following umbilical infection by streptococci. Death occurred on the thirteenth day, the infection having occurred very shortly after birth. A thorough examination of the specimens showed infection with streptococci and other bacteria to be the cause of the hæmorrhages. These hæmorrhages were found in the connective tissue beneath the epidermis, beneath the serous membranes and mucous membranes, and also in the kidneys. A second illustrative case is also reported, in which, in a prematurely-born child, death occurred with symptoms

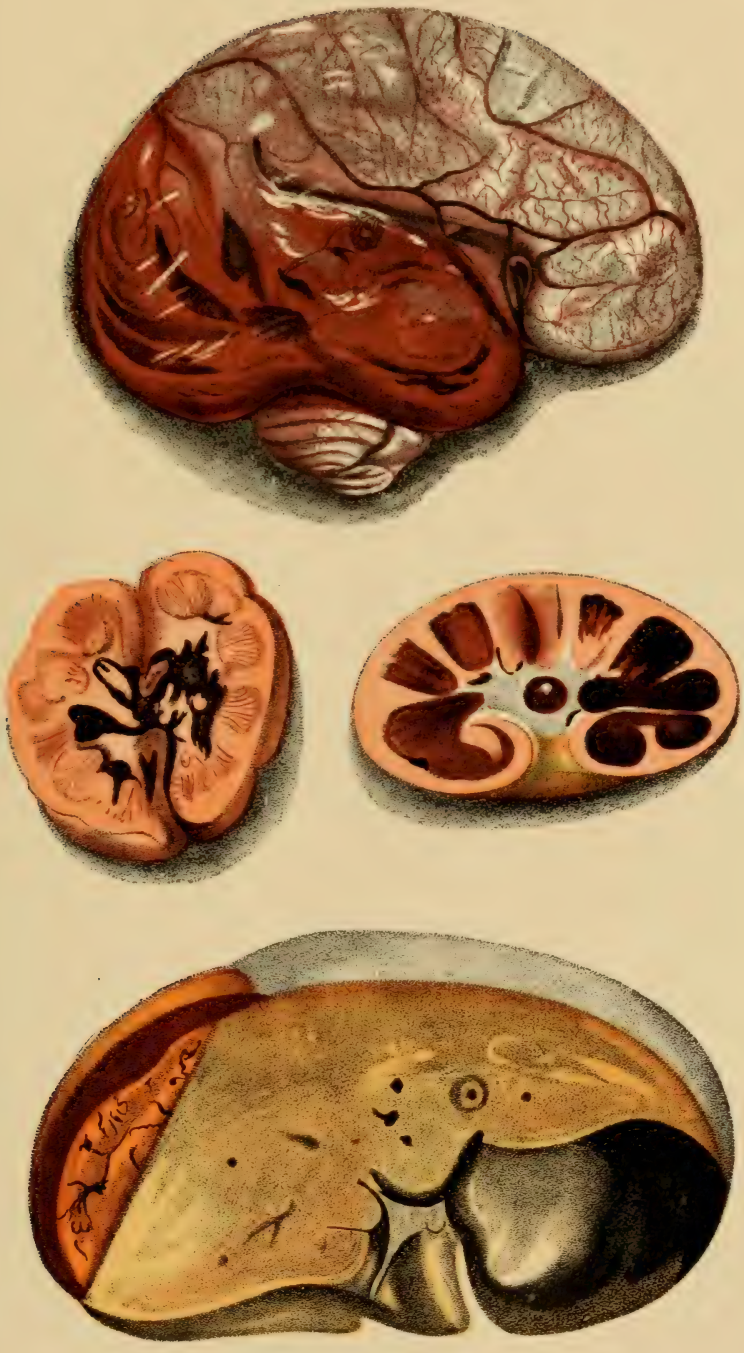
of pneumonia. Examination revealed the fact that the pneumonia had been caused by infection with staphylococci. The peculiar form of the hæmorrhage —namely, into the parenchyma of various organs—excluded hæmorrhage from mechanical injury. Further, the rapid and easy birth of a small fœtus tended to exclude the possibility of mechanical injury.

By far the most frequent cause, however, of hæmorrhage in the new-born is direct mechanical injury received during birth. Such injury is usually suspected after difficult extraction by the forceps or by version. As pelvimetry is more extensively practised the induction of premature labor will render these cases more and more infrequent; but at present they occur with sufficient frequency to form an important complication of labor. Under the head of *apoplexy neonatorum* Ashby and Wright describe cases of hæmorrhage from the *pia mater* following compression of the umbilical cord and pressure upon the brain-substance during birth. Convulsions may be present in such cases, and if paralysis occurs it is probably peripheral, resulting from effusion of blood at the base of the brain, on the pons, or the origins of the cranial nerves. McNutt has reported 10 cases of cerebral hæmorrhage following labor; in 7 of these cases the head presented; in 3, the breech. In all the latter cases paralysis occurred, but only localized convulsions. McNutt infers that hæmorrhage, limited to the convexity of the cerebral hemispheres, is more apt to follow delivery in breech presentation.

Various forms of cerebral hæmorrhage are described by other observers, and especially in cases following prolonged application of the forceps or forcible extraction after version. In our own observation we recall the case of an infant delivered with axis-traction forceps without especial difficulty; progressive feebleness of respiration, failure to nurse, and apparent exhaustion caused death in thirty-six hours after birth. On post-mortem examination, over the parietal regions of the skull the tissues of the scalp were intensely congested, although no gross lesion, as rupture or fracture, could be discerned. Beneath these portions of the skull and scalp the cortex of the cerebrum was filled with punctate hæmorrhages, and over the point of greatest convexity the brain-substance was materially softened. Similar cases, which would not be found infrequent if post-mortem examinations in such patients were extensively held, are readily explained by the anatomy of the cranium and its contents in the new-born. Virchow and others have shown that the blood-vessels of the infant's brain are thin and small, and most readily injured by abnormal pressure. An interesting example of this fragility is found in cerebral hæmorrhage following death from asphyxia, where mechanical injury to the cranium can be excluded.

In medico-legal practice Richardière emphasizes the fact that such cerebral hæmorrhage may be differentiated from hæmorrhage occurring later in life by the absence of inflammation of the arachnoid and of the dura mater. Meningeal hæmorrhage in the new-born is often accompanied by subpleural ecchymoses; death usually results suddenly. A most valuable recent contribution to the literature of this subject is that of Spencer. In a total of 180 bodies examined, 130 were in a condition which enabled a critical examination of the tissues to be made: in 85 injuries to the brain were found, consisting of congestion and hæmorrhage; these conditions varied in severity, in situation, and in extent. Œdema was a frequent accompaniment. The children had been delivered in various ways, and many of the cases occurred in children the subjects of disease. The accompanying plate shows a typical condition of meningeal hæmorrhage (Plate I.). Its frequency will be appreciated when it is known that $4\frac{7}{10}$ per cent. of all hæmorrhages occurring in the new-

PLATE I.



Visceral Hæmorrhage in the Newborn (Spencer, *Transactions Obstetrical Society, London*, vol. 33).

born are meningeal in character. Spencer also describes a case, similar to the one which we have mentioned, of hæmorrhage into the substance of the brain. It is interesting to note that, so far as the causation of cerebral hæmorrhages is concerned, the forceps is the most frequent agent in producing them, and next presentation by the breech or foot. As determining causes softness of the skull and relaxation of the sutures are of considerable importance.

In Spencer's cases, next in frequency and importance to hæmorrhage into the brain comes parenchymatous hæmorrhage into the liver, kidneys, and suprarenal capsules. Well-marked congestion was frequently observed; hæmorrhage was present in $28\frac{46}{100}$ per cent.. This hæmorrhage was often upon the upper surface of the liver and followed birth in head presentations. Such hæmorrhages usually appeared as blebs filled with blood. Of equal frequency was hæmorrhage into the substance of the kidneys, usually beneath the capsule. Such cases were most frequent in breech presentations (Plate I.). The suprarenal capsules were also the seat of frequent hæmorrhage. Injuries to the lungs in the form of congestion and hæmorrhage were next in frequency. Most often this took the form of subpleural bleeding; less frequently, as hæmorrhage into the lung-substance.

These pulmonary apoplexies are often followed by pneumonia, and are a frequent cause of death. Such infants are usually cold and blue, with subnormal temperature and feeble cry, and do not nurse. The abdominal and pelvic viscera, besides those mentioned, are also the frequent site of congestion and hæmorrhage. As regards the causes, Spencer recognizes a delicate condition of the blood-vessels as of great importance. Alteration of the blood, already described, is also recognized, while asphyxia predisposes to hæmorrhage. Direct mechanical violence is a familiar exciting agent.

Experience abundantly proves that most cases of severe hæmorrhage arise where disproportion in size between the fœtus and the pelvis exists; there can be no rational prophylaxis of these injuries that does not rest upon an estimate of the mother's size and the relative size of the fœtus. We cannot too strongly urge, as we have already done, that pelvimetry be uniformly practised by obstetricians, and that, in addition, an effort be made in all cases to estimate the relative size of the fœtus and the birth-canal. To be of service to the patient such efforts at diagnosis should be made between the seventh and eighth months of pregnancy.

So far as the treatment of the infectious disorders which attack the blood, resulting in hæmorrhage, is concerned, the faithful practice of antiseptic precautions will diminish very largely these complications. The need for such observances is proven by the familiar fact that at the present time the mortality of infants in private houses is greater than in well-conducted maternities, the reason being that the practitioner considers the private house and the private patient objects for less anxiety than the hospital patient; neglecting antiseptic precautions because the patient is a private one the result is often disastrous.

Asphyxia.

Interference with the oxygenation of the fœtal blood results in asphyxia. By far the most common and dangerous causes of this complication are those which arise while the child is still in the uterus, and which have nothing to do with the access of the external atmosphere to the child's lungs. When this is kept in mind, it will be seen that asphyxia is a complication of labor itself, not so much a condition arising at delivery and requiring subse-

quent treatment. The most frequent cause of this condition is pressure upon vessels of the placenta or umbilical cord, resulting in blood-stasis in the fœtus; or occasionally sudden collapse and death on the part of the mother. The symptoms of asphyxia in the fœtus are those of carbon-dioxide poisoning—a rapid, feeble pulse, pallid appearance of the surface of the body, with the phenomena caused by intense congestion of various organs, ending in heart-failure. Asphyxia has been variously divided, some writers describing an apoplectic form and others a pallid form. These are but variations of the same condition, and are distinctions without essential differences. During the first stages of asphyxia the phenomena of congestion predominate: the face of the child is suffused, the mucous membranes bluish, the heart-beat at first slow and more vigorous than normal, while the reflexes still remain. As the process goes on and congestion has been followed by engorgement and œdema, the surface of the body is pale, the pulse small, rapid, and feeble, while the mucous membranes have the peculiar grayish-blue appearance characteristic of impending death. In the first stages of asphyxia the pulse in the umbilical cord is present, and may be vigorous. In the second stage the cord is pulseless, and shares the pallid appearance of the fœtus.

The complications of labor which most frequently cause asphyxia are partial detachment of the placenta, compression of the umbilical cord, pressure upon any large portion of the fœtal body, especially upon the head and brain, or the sudden death of the mother. So soon as the tissues experience what has been styled "hunger for oxygen," there ensue reflex respiratory movements: by experiment these may be demonstrated to happen within the uterus before the rupture of the membranes; they frequently occur during the second stage of complicated labor. They result in the inspiration of amniotic liquid or the secretions of the mother's birth-canal; if these respiratory efforts are vigorous and prolonged, inspiration pneumonia may result—a catarrhal pneumonia caused by the inspiration of mucus or pus, developing, if the child survives, immediately after birth, and frequently proving fatal.

The child before labor is in a condition of physiological apnœa. The blood of the fœtus contains an excess of hæmoglobin at the moment of birth, stated by Cattaneo to be relatively $120\frac{2}{10}$ per cent. No differences can be distinguished between arterial and venous blood in the umbilical cord in the amount of hæmoglobin contained. So perfect is the provision of nature for supplying the fœtus with oxygen that anæmia on the part of the mother does not seem to influence the amount of hæmoglobin in the fœtal blood nor in the blood of the child immediately after birth. The rapidity and ease with which the fœtal blood absorbs oxygen is illustrated by the fact that in from thirty-six to forty-eight hours after birth the blood of the new-born contains its greatest amount of hæmoglobin. Late ligation of the umbilical cord results in more hæmoglobin in the fœtal blood. Curiously enough, a small placenta increases the amount of hæmoglobin in the fœtal blood, while a large placenta diminishes it. At the moment of birth the circulation of blood in the placenta and the child is markedly interrupted, oxygenation is materially lessened, and the fœtus undergoes a period of more or less danger. It can be readily understood how delayed labor, where the exhausted uterus in tetanic contraction presses upon the child and the placenta, may occasion death from asphyxia, and this without extensive gross lesions.

Asphyxia, again, may depend upon defective muscular and nervous development in the fœtus. As a result, the fœtus fails to make respiratory movements after delivery, and perishes from actual weakness. Diseases which affect the respiratory apparatus, either by structural changes or mechanical pressure, may

cause asphyxia. Pulmonary syphilis, enlargement of the liver, dropsy, and various tumors come under this head. These cases usually perish from atelectasis. The blood-vessels in such cases rupture easily, and small multiple hæmorrhages abound.

Prognosis in cases of asphyxia depends upon the condition of the nervous centres. If the asphyxia is but partial, and the stage of congestion be present, as evidenced by the dark reddish-purple complexion of the child and the slow but full pulsations of the heart and umbilical cord, recovery in the majority of cases will ensue. If, however, the child is pallid, the heart-beat rapid and feeble, and the cord pulseless, the prognosis is grave. More than 1 per cent. of children born living perish from asphyxia; while cases have been reported where children, born asphyxiated, subsequently developed serious pathological conditions of the nervous system. Recalling what has been stated regarding the richness of the fœtal blood in hæmoglobin, cases where children born asphyxiated have survived for hours, although thought to be dead, are readily explained. Beale described a case in which the mother died from post-partum hæmorrhage shortly after delivery; the midwife in charge reported the birth of dead twins, which she put in a basket in a shed; on examination three hours afterward, one child was found breathing feebly. Efforts to establish respiration were fruitless. The temperature in the shed was very low, the weather being cold. Children have respired feebly eighteen minutes after birth and twenty-five minutes after birth in breech presentation. Beale reports successful efforts, lasting several hours, to resuscitate a child thought to be dead. A case is reported where a child was buried a foot under ground, and not exhumed for five hours, when evidences of life resulted from efforts at resuscitation continued for two hours. It is curious to observe that the chances of recovery in asphyxia are much better when the infant is exposed to cold than when to heat, probably from the fact that a low temperature retards the metabolism of the cell-elements of the body, and thus the nervous centres retain their irritability longer.

Treatment of asphxyia is prophylactic and curative. In prophylaxis the conditions which will result in prolonged labor should be anticipated and removed. Complicating factors which will subject the child to great pressure must also be obviated. The judicious use of the forceps is a direct prophylaxis against asphyxia, as are version and extraction. On the other hand, both of these procedures are direct causes of asphyxia in unsuitable cases. We must again repeat that no intelligent prophylaxis of asphyxia can be undertaken which does not include a preliminary examination of the mother's birth-canal and an estimation of the relative size of the fœtus and the mother. Prolapse of the umbilical cord, resulting in pressure and asphyxia, is best treated by anæsthetizing the mother and terminating labor, if possible, by manual interference; thus, the cord may be taken in the hand and passed up into the uterus, the head brought into a proper position, and delivery expedited by the forceps; or, if pulsation in the cord has ceased, version and extraction may be performed. There is no repositor for the cord comparable to the hand of the obstetrician, for the hand can recognize pulsation, can remedy coiling of the cord about the fœtus, and may so change the position of the cord as to lead to the recovery of the fœtus.

In cases of contracted pelvis, or in disproportion between the fœtus and the pelvis, operative procedures have for one of their purposes the saving of the child from asphyxia, which otherwise must prove fatal. So soon as the head is accessible during labor, the practitioner should ascertain, if possible, whether the cord is coiled about the neck; if so, it should be gently drawn

down and loosened; and if the head be born, the cord tightly coiled about the neck, and a large body and shoulders hinder delivery, it is well to cut the cord and deliver the child rapidly. The cord may be clamped with artery-forceps, or, better, tied. The diagnosis of cord around the child may sometimes be made before expulsion by hearing a murmur in the umbilical cord during auscultation of the abdomen.

The treatment of the actual condition of asphyxia after delivery will depend largely upon the degree of asphyxia present. There are certain precautions which should be taken in every birth. The nurse should have ready a saturated solution of boracic acid to which has been added a teaspoonful of glycerin to the half pint. This should be at hand in a small, clean earthen bowl. In the bowl should be a half-dozen pieces of old, soft handkerchief, two inches square. When the head is born, the physician turns the mouth and eyes of the child in such a position that they will not come in contact with the discharges of the mother. The nurse or physician should then thoroughly cleanse the mouth and fauces with the bits of linen soaked in the boracic solution. Mucus or secretions in the child's mouth will thus be removed, and one danger of asphyxia obviated. In the stage of asphyxia where congestion is the principal symptom, the stimulus of contact with the external air will often secure respiratory movements: spanking the child is a familiar method of procedure which undoubtedly has good results. In such cases the cord may be promptly tied and cut; and if the congestion be pronounced, it is well to allow a drachm or two of blood to flow from the fœtal cord before ligation. The child should then be promptly inverted to favor the expulsion of mucus from the air-passages. If the heart-beat be good, a little cold water sprinkled upon the chest will usually result in the establishment of respiration. Should the heart-beat be good, but respiration not ensue, the child may be laid in a bath-tub filled with water at a temperature of 100° F., and passive respiratory movements may be instituted. Cold water also may be sprinkled upon the chest. In these cases a prognosis may be based upon the action of the heart; if that be strong, the physician should not despair of securing respiratory movements.

In the more severe forms of asphyxia the child can endure no loss of blood; it may be promptly inverted and held in that position for several moments, its mouth being thoroughly emptied of mucus and secretions: passive respiration is then to be instituted, and to secure the actual entrance of air into the lungs the Schultze method is undoubtedly pre-eminent. It consists in taking the child with both hands, the child's head raised between the upper portion of the palms, the fingers grasping the scapulæ of the child, the thumbs resting upon the anterior surface of the thorax. The child is then raised above the head of the physician until it turns a three-quarter somersault; it is then brought down with a swinging motion to within a short distance of the floor. When the body of the child is raised over the head of the physician expiration results: as the child swings forward and downward the action of gravity and the pressure of the physician's hands result in a powerful inspiratory action. The value of the Schultze method consists in its efficiency in introducing air into the lungs; it is not, however, a stimulus to the reflex excitability of the nervous system, and if this has been lost, an infant's lungs may be filled with air and yet the child readily perish. The dangers of this method have been pointed out by Meyer and Heydrich. Fracture of the clavicle with perforation of the lung and emphysema are reported by these observers as occasionally following this method of resuscitation.

A manifest objection to the Schultze method is the disturbance and shock

which must necessarily follow; in deeply asphyxiated children, where the heart-beat is scarcely perceptible, it is preferable to practise the inverted posture, with the application of warm flannel to the surface of the body and the continuation of gentle respiratory movements. Air may be introduced into the lungs by mouth-to-mouth insufflation or by the passage of a tracheal tube. Lusk advises the use of the catheter, not only to remove mucus, but to favor direct insufflation; or the chest-walls may be compressed to secure expiration. When circulation reappears, Silvester's method is then of service, the tongue of the child being drawn forward. When heart-beats are perceptible, the warm bath, with sprinklings of cold water upon the face, is useful. Finally, he advises Schultze's method to favor complete re-establishment of the circulation. Schultze claims for his method an immediate action in relieving overloaded blood-vessels, the swinging of the child producing emptying of the ventricles and favoring the return current from the pulmonary vein.

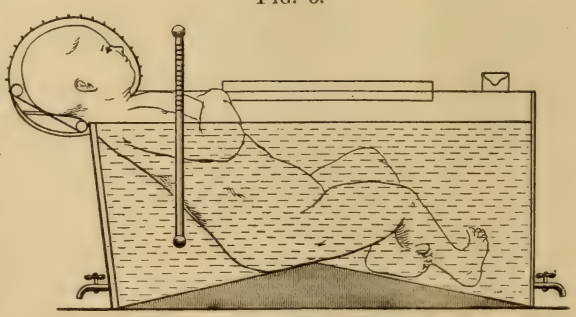
The value of direct insufflation by the catheter, preceded by the removal of mucus, can scarcely be over-estimated. We recall a case in a foreign hospital where the assistant in charge had abandoned an asphyxiated infant as dead; permission was given several American students to practise the passage of the balloon catheter, an English catheter having a rubber bulb at the distal end, whose compression and expansion favor suction and insufflation. To our surprise, the child became resuscitated under the use of the catheter, and ultimately recovered. Forest places the child first on its face, its head down, and expels fluids from the mouth by pressure upon the back. The child is then put in a bath or tub of hot water in a sitting posture, supported by one of the operator's hands across its back, its head bent backward. The physician grasps the child's hands with his other hand, carries them upward until the child is suspended by the arms, leans forward himself and blows air into the child's mouth; the infant's arms are then lowered, its body is doubled forward, and its thorax pressed between the hands of the physician. Air is thus expelled. Especial advantage is claimed for this method from the fact that the hot water maintains capillary circulation and tends to assist in promoting the action of the heart. Reynolds places the infant upon its back, head downward, resting upon the operator's forearm, held nearly perpendicularly to the floor, retained in that position by his fingers hooked over its shoulders. In this position the child's arms fall downward by the sides of its head, and their weight, aided by that of the thorax itself, draws the ribs into the position of complete expansion of the chest. The thorax is compressed against the forearm by the other hand, and suddenly released, when a most satisfactory respiration is the result. This method combines a favorable posture for the escape of fluids from the trachea and for the afflux of blood to the brain, with a ready method of artificial respiration. Duke places the infant face downward, its thorax resting upon the open palm of the left hand; the ribs are gently compressed by the other hand: the mouth is cleansed, and the finger passed down the pharynx to admit air. If this is not successful, the child is plunged into a hot bath. Richardson urges that the child's body remain quiet during efforts to establish respiration. The feeble condition of the heart strongly contraindicates violent disturbance to the child. The position of the body should be horizontal. Air introduced should be warmed to 90° F. Manual respiration by Silvester's or Hall's method is recommended, and Richardson describes an apparatus composed of a pair of bulbs by which air may be pumped into the respiratory passages. Two pieces of tubing are passed to the nostril, and a bulb upon one injects air, while a bulb upon the other favors the discharge of mucus and vitiated air.

He also describes a method of using a simple bellows in connection with a nasal tube. The treatment of asphyxia by tracheotomy is seldom successful; there is rarely an impediment in the respiratory passages of the child which cannot be overcome by the introduction of the catheter.

In reviewing the treatment of asphyxia we desire to call attention to the pathology of the affection and to the relative value of different methods of treatment. The removal of mucus from the nostril, trachea, and bronchial tubes can be most readily effected by suspending the child in an inverted position; this favors also afflux of blood to the medulla and respiratory centre. Gentle, passive respiratory movements should be employed, but so conducted as to give the child the least disturbance possible. The return of the circulation and the reflexes should be eagerly awaited, and so soon as these phenomena are present the prognosis becomes much more favorable. The warm bath and the application of a mild counter-irritant—cold water, spirits, simply a current of air from bellows directed against the epigastrium—usually cause respiratory movements. In strong children, when the reflexes are present and the heart-beat becomes perceptible, Schultze's method, practised gently for a short time, is of value. Should the circulation fail, it is admissible to inject hypodermatically $\frac{1}{100}$ of a grain of strychnia and a few minims of tincture of digitalis. If mucus is not expelled by the inverted position, the use of the catheter with suction and insufflation is advisable. When respiratory efforts have become established, but repeatedly fail, a mild faradic current of electricity and the inhalation of oxygen under pressure are of decided value. One pole of the faradic battery should be placed at the back of the neck, and the other over the thorax and alternately over the epigastrium. Bonnaire obtained good results in fœtal asphyxia by inhalation of oxygen—a procedure which we have repeated with like good results in fœtal asphyxia and that of older children complicating pneumonia. As Lusk remarks, in cases of deep asphyxia patience, watchfulness, and a hopeful spirit are prerequisites of success.

Following asphyxia, the infant is exposed to danger of death from inanition, and, as has been stated, from catarrhal pneumonia. The use of the incubator is of especial value in maintaining the circulation in these cases, and favoring the gradual expansion of the lungs if atelectasis be present. Winckel has obtained good results from the permanent hot bath at a temperature of 98.6° to 100° F. every twelve to twenty-four hours. Such children are fed every two hours. The bowels are promptly emptied by rectal injections. Winckel has devised a bath-tub for such cases, an illustration of which is appended. We add also an illustration of a modification of Auvard's incubator, which we have used successfully in the Philadelphia Hospital and in the Maternity Department of the Jefferson Hospital.

Fig. 3.

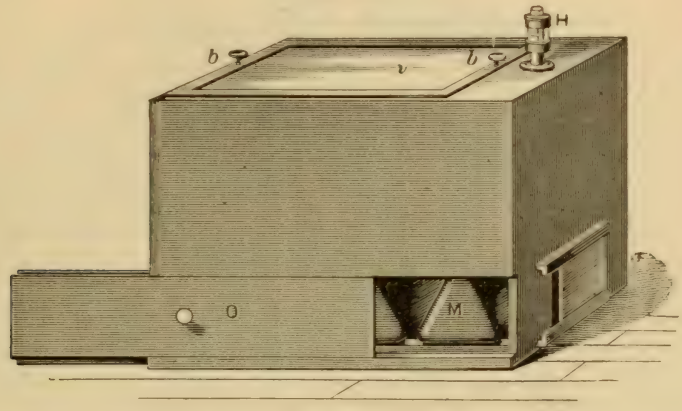


The Permanent Bath. (Winckel).

The interior of the box is divided into two parts by an incomplete horizontal partition, placed about six inches above the bottom of the box. In the lower part, which is intended for hot cans, two openings are necessary—one at

the side, occupying the whole length of the side, closed by a sliding door opened at pleasure from either end, as a means of placing the hot cans. The

FIG. 4.

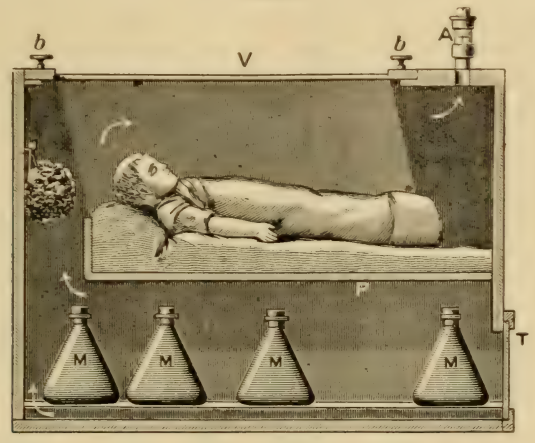


Incubator.

b, *b*, lid with glass plate; *v*, glass plate; H, ventilating tube; O, slide closing hot-air chamber; M, hot-water cans.

other opening is at one end of the box, closed by a door not fitting tightly, to admit a small amount of air. The upper part, arranged to receive the infant,

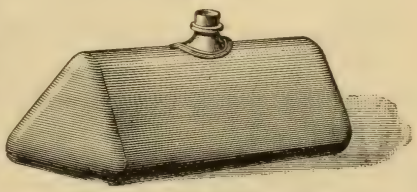
FIG. 5.



Interior of Incubator.

is covered on top by a plate of glass, fitting completely, with two buttons or knobs to admit of its being easily raised. On the top is also arranged a small metal tube containing a small rotary fan very easily moved by a weak current of air. In the opening where the two compartments join a sponge is placed, wet with water to humidify the air, and a thermometer by which to regulate the temperature.

FIG. 6.



Hot-water Can for Incubator.

Cases are not infrequently met with where death occurs soon after labor with

symptoms of partial asphyxia: a clear diagnosis is often impossible, until post-mortem examination reveals partial heart-clot, syphilis, atelectasis, or lobular inspiration pneumonia as the cause for this mortality.

Hæmorrhages from Mucous Surfaces.

The new-born infant often presents hæmorrhages from mucous surfaces of the body. Among the most frequent of these is a discharge of blood from the vagina, occurring at birth and persisting afterward. An examination of the mucous membrane in these cases frequently detects a condition of capillary granulation which bleeds easily upon the slightest movement of the child. In a case recently under our observation at the Maternity Department of the Jefferson College Hospital an ill-developed female child presented this phenomenon at birth. A blood-count made of this child, and compared with that of a healthy infant, shows the following:

Healthy Child.—Red corpuscles per cubic millimetre, 5,450,000, by counting forty squares (Thoma-Zeiss hæmocytometer). White corpuscles per cubic millimetre, 11,000. Proportion of white to red, 1 : 495. Hæmoglobin, 65 per cent. of normal. Blood-plates by objective, blood prepared by means of Hayem's solution: the number was much less than the usual amount, which should be about 250,000. The red corpuscles were irregularly formed, some crenated, some small and granular, others apparently rolled or turned upon themselves, resembling very much a bread roll. While this irregularity existed, their appearance was that of normal corpuscles, and the percentage of hæmoglobin (65) proved them to be almost normal. In children the percentage of hæmoglobin is not so great as in adults; in the young or in any case where the growth is rapid the red corpuscles are always irregular in appearance, which is not at all indicative of disease. The slight increase in red corpuscles is normal to the new-born. (Plate II. Fig. 1.)

Anæmic Child.—Red corpuscles per cubic millimetre, 2,000,000. White corpuscles per cubic millimetre, 12,000. Proportion of white to red, 1 : 166. Hæmoglobin, 35 per cent. of normal. By careful examination no blood-plates could be found. In this case the red corpuscles were irregular, crenated, granular, and many disintegrated. By actual count this specimen would give over five million red corpuscles per cubic millimetre, but counting normal corpuscles would give only two million. The object of the count being to know the number of oxygen-carriers per cubic millimetre, it would give a wrong idea to enumerate those disintegrated and diseased corpuscles. There was a slight increase in the number of white cells, but their appearance was normal.[1] (Plate II. Fig. 2.)

The condition underlying such hæmorrhage is that of anæmia or malnutrition of the blood, with resulting ecchymoses. In parts accessible to treatment, as the mouth, vagina, rectum, or bladder, injections of hot dilute creolin solution or boracic solution are indicated. Treatment of the anæmia, however, by administration of food, by arsenic, inunctions with oil, and the administration of olive or cod-liver oil will result in gradual recovery.

Obstetric Paralysis and Injuries to the Nervous System.

Direct injury to the nervous system received during birth has long been recognized as among the dangers to which the infant is exposed. Paralysis of

[1] For the examination and description of the blood in these cases I am indebted to Dr. D. B. Kyle, Instructor in the Examination of the Blood in the Jefferson Medical College. Dr. W. H. Wells, one of the physicians to the Jefferson Maternity, has prepared the drawings illustrating the appearance of the corpuscles.

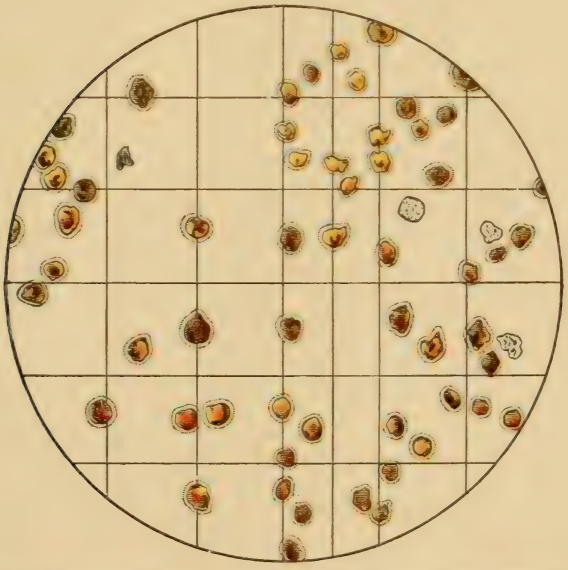
PLATE II.

FIG. 1.



Blood of Healthy Child one month old. Hæmoglobin normal. Drawn from Thoma-Zeiss Hæmocytometer. Objective $\frac{1}{8}$ Reicherts. Blood-count by Dr. Kyle; drawing by Dr. Wells.

FIG. 2.



Blood of Anæmic Child suffering from Hæmorrhage from Mucous Membranes. Total corpuscles, 5,000,000, of which 2,000,000 were normal. Blood-count and drawing as in preceding figure.

the facial nerve caused by pressure with the forceps upon the nerve at its foramen of exit often follows instrumental delivery. The brachial plexus is also frequently injured by the same agent. Hemiplegia, idiocy, and impaired cerebral development have been ascribed as consequences of injury received at birth. The view previously held, that the forceps is a valuable agent for compressing the fœtal head and exercising leverage and forcible rotation, has given place to the belief that the forceps is essentially a tractor, and that the mechanism of rotation depends upon the relation in size and symmetry between the head and the pelvis, and, as well, the resistance of the pelvic floor. Murray has shown by experiment and clinical observation that the fœtal skull is compressible in an antero-posterior direction by the sliding of the occipital and frontal bones under the ends of the parietal bones. This compression is not accompanied by any appreciable increase of the transverse diameter. The antero-posterior shortening is compensated for by a vertical elongation of the skull, providing for the accommodation of the cranial contents. These conclusions are, however, based upon the employment of axis-traction, without which such compensatory elongation cannot be confidently assumed. Murray was also careful to avoid forcible traction. Under such circumstances it may be held that moderate pressure with forceps, resulting in compensatory elongation of the vertical diameter of the fœtal skull, need not be expected to cause paralysis, hæmorrhage, or fracture. This pressure, however, must be gradually applied, and traction made in the axis of the pelvis; otherwise a portion of the head will be forced against the promontory of the sacrum, and injury must result. When gentle axis-traction fails to cause the head to descend, a diagnosis of disproportion between the head and the pelvis should be made, and efforts at forcible delivery should cease.

The results of injudicious delivery with forceps are well illustrated by Lane. A boy sixteen years old, delivered at birth with forceps, exhibited a groove three and a quarter inches long from the right coronal suture to the lambdoid; the floor of this groove seemed one-fourth of an inch below the scalp; the left arm was weaker than the right, and its movements defective. The left leg was weak. Reflexes were exaggerated and clonus was present. The depressed portion of bone was raised; the bottom of the depression encroached upon the area of the skull. Prompt amelioration of the epilepsy followed. Duchenne, Gueniot, De Paul, Rogers, and others have described injuries to the brachial plexus caused by forceps and by manual extraction of the child. Erb has clearly described injuries to the brachial plexus accompanying delivery in breech presentation. Hoedamaker describes injury to the fifth and sixth cervical nerves resulting from delivery in breech presentation when the arms become extended above the head. Feriberg describes a case of paralysis caused by pressure upon the brachial plexus during delivery after version; paralysis was but temporary, the patient subsequently making a good recovery.

The medico-legal aspect of injuries to the new-born child requires the differentiation of lesions received during birth by forceps or the pressure of the mother's pelvis, and injuries occurring by precipitate labor without assistance or by the wilful act of the mother or an accomplice. Dittrich reports cases of depression in fœtal bone, bounded by a well-defined ridge, following application of the forceps in cases of contracted pelvis. Küstner describes funnel-shaped depressions in the fœtal skull following forcible delivery by forceps. Von Hofmann has found a spoon-shaped depression the most frequent form of lesion in a considerable number of cases. Fracture of the orbital region of the skull has been observed by Lihotzky to follow forcible forceps delivery. Rupture of a meningeal vein and death from hæmorrhage have been observed and

reported by Koffer in the clinic of Gustav Braun. Kundrat reports an interesting case of depression upon the parietal bone of a new-born infant, with cerebral hæmorrhage, in which the evidence seemed to show that the lesion was caused by direct violence on the part of the mother after the birth of the child. Von Hofmann has further drawn attention to injuries to the fœtal cadaver which might occasion suspicion of intentional violence during birth. Naturally, defects in the ossification of the skull may result in lesions accompanying normal labor and simulating injuries at birth.

Fritsch describes the characteristics of injuries caused by precipitate labor, the child falling upon the floor or ground, to be as follows: The fracture begins in a suture, and extends outward to the middle of the bone; usually there is but one fissure, which ends where the bone is thickest. The parietal bone is most often affected, the fissure ending in the parietal eminence. As a general distinction, it is to be observed that direct violence is accompanied by hæmorrhage; that injuries examined immediately after birth, where fracture occurs, show frequently a well-defined border to the lesion, which tends to grow less sharp in contour if the child survives. Kundrat also lays stress upon the relative breadth of the sutures as a factor in influencing hæmorrhage during birth.

A most interesting question arises as to the bearing of these injuries upon the future health and development of the child. Osler found, in the records of the Philadelphia Infirmary for Nervous Diseases, 9 cases of paralysis following forceps delivery; in 6 of these it was reported that the forceps injured the child: some of them had scars following labor. In all cases the paralysis gradually appeared within a short time after labor. M. Allen Starr describes cases of brain-atrophy manifesting itself in hemiplegia, mental defects, and sensory defects, accompanied frequently by epileptiform seizures, and resulting from congenital conditions or lesions occurring at birth. Sachs and Peterson in 49 cases of congenital cerebral palsy found 16 in which some difficulty in labor occurred. These statistics are now more comprehensive than those of Little and Gaudard, Wallenberg and Osler. Sachs and Peterson, however, include all forms of cerebral paralysis and of tedious labor as well as instrumental delivery. Sachs has expressed the opinion that prolonged labor does more injury to the child's brain than the proper application of forceps.

We have considered the prophylactic treatment of these conditions under that of the treatment of visceral hæmorrhage. The question arises, however, What shall be done in a case in which a child is born and survives with such an injury? Although we find no record that such a procedure has been attempted, yet the suggestion of Nancrede and other surgeons that depressed bone be elevated by surgical interference is certainly rational. We believe that where pressure-symptoms are present, or where the lesion is extensive and follows severe pressure, such should be the line of treatment. The success attained in operating immediately after birth upon cases of umbilical hernia gives encouragement to the belief that surgical interference in these cases is justifiable. It is interesting to note a superstition common among the laity in some quarters to the effect that the doctor by manual pressure and counter-pressure is expected to shape the head of the child during the first few days after its birth.

Fractures and Dislocations of the Trunk and Extremities.

The skeleton of the fœtus may be fractured while in the uterus. Such fractures, however, must be carefully distinguished from congenital malformation, which closely simulate fracture. Amniotic adhesions during the first and second months of intra-uterine life are the most frequent causes of these mal-

formations. An apparent scar is often present in these cases, and must be referred to precipitate flexion of undifferentiated layers in the embryo. Spurious callus may be present, caused by defective development of the bone, although the amount of callus is less than after actual fracture. Sperling would distinguish between malformation and fracture by the fact that in malformation the fingers and toes of the limb affected show defective development, while in fracture such defective development of fingers and toes is absent. Hodgen describes a fœtal skeleton containing sixty-five fractures which he thinks were caused by muscular action during uterine life. He describes also, in a healthy child, a fracture of the clavicle, which was not discovered for several days after birth; the child was large and was delivered by forceps.

The most frequent fractures in the long bones are those of the clavicle, humerus, and femur. Fracture of the clavicle near its acromial end is occasionally complicated by severe injury to the brachial plexus, as illustrated in a case reported by Knight; permanent injury of the shoulder with paresis followed. Fracture of the clavicle is most frequently caused by forcible extraction of the shoulders.

Fracture of the humerus most frequently occurs in the delivery of the after-coming head when the arms become extended above the head. Fracture of the femur usually results from difficult version and extraction. Fractures of the bones of the leg, of the ribs and sternum are rarely met with, and only in cases of forcible extraction through highly-contracted pelves.

Dislocations of the fœtal skeleton are frequently confused with fracture, and are caused by the same manipulations which give rise to solutions of continuity. Dislocation and separation of the epiphyses of the humerus at the elbow-joint have been not infrequently observed after manipulation.

The treatment of fractures and dislocations of the trunk and extremities is based upon the principles of surgery commonly followed. Difficulty has been experienced in maintaining the fragments in apposition by reason of restlessness in the child, and the necessity to move it frequently when it nurses and when it is cleansed. Fractured clavicle will heal without deformity with a very simple retention dressing if the infant be kept assiduously upon its back. Fracture of the humerus and of the femur may be treated to advantage by some form of splint material which can be dipped in hot water, moulded to the child's limb, and retained in position by a simple roller bandage. Firm and unyielding dressings must be avoided in these cases, as the danger of injury to the tissues by pressure is very great. Fractured ribs and sternum may be successfully treated by a broad flannel bandage pinned smoothly about the chest. Dislocations require the same principles of treatment which should be followed in managing fractures.

The prognosis in fractures of the fœtus is usually good. As most of them are of the "green-stick" variety, a favorable result without deformity is the rule rather than the exception. When congenital malformation is present, the practitioner should be guarded in his prognosis. He may remedy webbed fingers and toes by dissecting them apart, but he will scarcely hope to see a congenitally malformed limb become perfectly developed.

Umbilical Hæmorrhage.

If the umbilical cord be tied firmly with an aseptic ligature after its pulsations have ceased, if the stump be powdered with boracic acid or salicylic acid 1 part to powdered starch 3 or 5, and if reasonable care be exercised to protect it from violence, hæmorrhage from the umbilicus or umbilical inflammation

rarely occurs. The cord may be best protected by enclosing it in a small mass of antiseptic cotton, directing the extremity of the stump upward and to the child's right, and pinning a flannel binder comfortably tight about the abdomen. In cases, however, where syphilis, hæmophilia, septic infection, and acute fatty degeneration, with hæmoglobinuria, are present, hæmorrhage may occur when the cord separates, or even before that time. This complication is not very frequent, Winckel having observed it but once in 5000 infants. Bouchut quotes Grandidier's analysis of 202 cases, from which he concludes that the hæmorrhage begins most often at night, and often accompanies colic, vomiting, somnolence, and jaundice, with ecchymoses of the skin. Bleeding occurs rather more frequently before the cord is entirely separated, and usually between the fifth and ninth days. The hæmorrhage takes the form of arterial oozing, the blood often failing to coagulate. The hæmorrhage may persist from one hour to several weeks. The mortality from umbilical hæmorrhage is estimated at 80 per cent.

The treatment is frequently futile. A needle, armed with a silk ligature, may be passed beneath the vessels and securely tied; two surgical pins may be passed beneath the bleeding tissue at right angles to each other, and the ligature may be looped around the pins. Pressure is indicated in treating umbilical hæmorrhage; it is best made with antiseptic cotton on which iodoform has been freely sprinkled.

Umbilical Polyp.

The umbilicus may fail to heal perfectly, and abundant granulations, bleeding upon touch, and polypoid growths may develop; they are best treated by the application of nitrate of silver or other suitable escharotic.

Umbilical Hernia.

A protrusion of the abdominal contents may accompany defective closure of the umbilicus. While it is indicated to palliate this condition by suitable dressings, yet it has been found possible to secure a radical cure by operation very soon after birth. Runge describes a case operated upon successfully sixteen hours after birth. In the majority of cases a cure may be effected, in a period varying from one to six months, by the application of an umbilical button. This consists of a hard-rubber disk convex on the applied surface, which is held in position by a broad band of surgeon's adhesive plaster.

Gastro-intestinal Hæmorrhage.

This complication depends upon a purpuric condition, and manifests itself most frequently from the fifteenth to twentieth day after birth. Kiwisch reports cases of hæmorrhage from the intestinal tract following the normal birth of apparently well-nourished children. The first symptoms were discharge of blood and restlessness, occurring from twelve to thirty hours after labor. The abdomen became dull and tumid, the patients were pallid, and in some instances vomited blood; death ensued within forty-eight hours.

According to Grynfeltt, gastro-intestinal hæmorrhages usually take place during the first three days after birth (Rilliet, Silbermann, Dusser), though in a case of this author's it occurred on the fourth and fifth days, and in two instances, seen by Rilliet, the children were fifteen and twenty weeks old. Sex seems to play no special predisposing rôle, but the influence of morbid

antecedents in the parents appears to be a factor of some importance. Pinard, Champetier, Auvard, and others have noted syphilis in the progenitors, but this is regarded by Grynfeltt as only a cause acting indirectly in deteriorating the health of the parents. Hæmophilia has certainly been proven in some instances.

The pathogeny is quite as obscure as the etiology. The lesions observed at autopsies are the most variable. Ulcerations of the stomach and intestines have been found ; again, only a simple congestion ; while other cases have shown a complete absence of visible lesion. Grynfeltt advances a theory suggested by observations of Billard, and confirmed by personal studies of the histology of the digestive mucous membranes of new-born infants. These show that the vascular supply of the mucous membrane of the stomach and intestines is exceedingly rich at this period of life. Adding to this state of physiological congestion a congestion or impeded circulation in the liver, he finds it easy to ascribe the cause of such hæmorrhages to exaggerated tension in the portal area. This view, he believes, is supported by the fact that these hæmorrhages, at first sudden and profuse, quickly cease, thus resembling a true depleting loss of blood.

The first symptom is usually the hæmorrhage itself. Blood flows from the mouth following efforts at vomiting, or from the rectum, more or less mixed with fæces or in clots; quite often both phenomena are coincident, hæmatemesis being usually the earlier. When one alone occurs, hæmatemesis is by far the more frequent. In spite of the gloomy prognosis evidenced by the statistics of Dusser (43 deaths in 78 collected cases), a more hopeful view must be taken.

In treatment, tannin in syrup of rhatany offers an efficient astringent potion. One and a half to two and a half grains of ergotin in mucilage are employed with satisfaction by Widerhofer of Vienna.

Icterus Neonatorum.

The physiological icterus of the new-born infant appears on the third or fourth day of life, is characterized by a yellowish pigmentation of the face and breast, persists for about a week, and does not seem to disturb the patient's general condition at all. The urine is dark in color, containing bile-stuff, while the stools lack the color usually given by their mixture with bile. The cause of such icterus is thought by Birch-Hirschfeld to be swelling of Glisson's capsule, commencing at the umbilical vein, and by œdema preventing the free discharge of bile through the hepatic vessels; hence the jaundice is hepatogenic. Hofmeier thinks icterus is caused by the enormous number of red blood-corpuscles which are formed in the liver and hinder the production and discharge of bile. The entrance of this coloring matter into the blood is furthered by catarrh of the duodenum and congenital stricture of the ductus choledochus. Halberstam found undissolved bile-stuff in the urine of children with icterus, and the epithelium of the kidneys infiltrated with the same coloring matter.

The harmless character of this jaundice and its spontaneous disappearance should not make it a subject of anxiety to the physician or parents; it sometimes is due to slight changes in diet or any temporary disturbance of the child's general surroundings. Beyond the regulation of the bowels by the most simple laxatives, no treatment should be employed for this condition. Infective jaundice will be considered under the head of infections which attack the fœtus.

The Infections attacking the New-born.

The recognition of bacteria, ptomaïnes, and toxines as causes of disease has served to explain many disorders of the fœtus and infant at birth not previously understood. Most frequent of these infections are those by the micrococci of gonorrhœa and the streptococci of suppuration. Gonorrhœa in the mother affords the best of grounds for fearing gonorrhœal infection in the new-born child. The most usual site of this infection is the conjunctiva, and ophthalmia neonatorum is a familiar sequence of maternal gonorrhœa. The treatment of this disorder will be considered in another section of this book. We are interested, however, in the practical prophylaxis of such infection: if the practitioner could be absolutely positive that the mother had never been infected by the gonococcus, prophylaxis would be entirely unnecessary. In hospital patients, however, there is always room for suspicion; and in private cases, although there may seem no adequate reason to fear such a complication, yet its appearance will often surprise and disappoint the attending physician. No information will be gained in this matter from interrogating the patient: if she has ever been infected, her husband has certainly not told her the cause of the disorder, and her physician may have kept her in like ignorance. Furthermore, in women who have never been infected by the gonococcus there occurs at the latter portion of pregnancy a vaginal discharge which is capable of setting up a mild conjunctivitis in the infant. Hence a practical rule may be followed to advantage, that where a vaginal discharge persists during the latter portion of pregnancy the use of antiseptic douches is certainly indicated. These douches may be, preferably, creolin or bichloride of mercury: the first has the advantage of impairing the natural condition of the mucous membrane of the vagina less than does the mercurial; it is also a safer substance to put in the hands of a patient. On the contrary, its odor is disagreeable to some, and when used in a strong mixture it causes considerable irritation and burning. In a strength of one teaspoonful to the quart the resulting mixture is seldom so irritating as to cause discomfort. The quantity used should be not less than a quart, and the douche should be preferably taken while the patient is in the recumbent posture. The douche-bag should hang not higher than three feet above the patient's body, and the force of gravity alone should be employed in giving the douche. If bichloride of mercury be chosen, 1 : 5000 is sufficiently strong for such use.

In patients admitted to hospitals, suffering from the effects of previous gonorrhœa or having acute gonorrhœa, the treatment must be more radical; here a preliminary thorough cleansing of the vagina should be made with green soap and creolin, the mixture containing 2 per cent. of the creolin: following this, creolin douches, four times in twenty-four hours for the ten days preceding labor, will be found of advantage. Should the mucous membrane not tolerate such frequent douches, the vagina may be tamponed with iodoform gauze containing 50 per cent. of iodoform, and the number of douches be reduced one-half. In all hospital cases a preliminary douche of green soap and creolin may be used to advantage; in private practice a preliminary douche of bichloride, 1 : 5000, may also be employed to the advantage of mother and child.

Aside from ophthalmia, gonorrhœa may infect the infant at birth upon other mucous membranes. Rosinski describes the results of interesting investigations made by him upon gonorrhœa occurring in the mouths of new-born infants. The lesions caused by this germ in the mouth develop only where the pavement epithelium has been removed. These cells are especially fragile

PLATE III



Gonorrhœa of the Mouth in the Newborn (Rosinski)

in the young child, and hence the readiness with which infection occurs. It is interesting to note that in gonorrhœal ophthalmia it is very rare to find that the lachrymal sacs become involved; it is also true that the cylindrical epithelium of the naso-pharynx seems also to resist successfully invasion by the gonococcus. Clinical observation shows that these cases develop usually between the fifth and tenth day of life, resulting often from infection from the genital canal occurring at birth, and oftentimes through direct infection at the hands of attendants. This is especially true where the epithelium of the mouth is destroyed through efforts at cleansing. These cases are remarkable for the fact that they affect the general health so little; the children nursing well and seeming free from pain. The lesions are yellowish plaques, surrounded by a border of pale-reddish tissue, in which the process of healing usually begins upon the third day by a reaction zone of deeper color. The epithelium is renewed from the borders of the plaque, pus-cells being thrown off as the healing progresses. Scar-tissue is never developed in these cases. The accompanying plate gives an excellent idea of the appearance of the lesions. (Plate III.)

The treatment of gonorrhœa affecting the mouth of the new-born consists in careful avoidance of injury to the epithelium; the finger should not be inserted into the mouth of an infant suffering from this disorder: the affected surfaces should preferably be sprayed with a solution of hydrogen peroxide or a saturated solution of boracic acid. Such treatment is usually amply sufficient to secure the recovery of the patient. The infant's general condition often requires attention in these cases, and its food and hygiene are matters of great importance.

General Septic Infection.

Streptococci, bacteria, and ptomaïnes of septic infection usually find entrance to the fœtal body through the granulating surfaces upon the umbilicus; the result is arteritis and phlebitis of the umbilical vessels, resulting in the formation of thrombi and the infiltration of the surrounding tissues with bacteria and ptomaïnes. Both umbilical arteries are usually involved, the infection extending from the umbilicus to the bladder. The umbilical ring may ulcerate, or may have healed entirely while the infection has proceeded within the abdomen. According to Weber and Runge, the tissue about the arteries is usually first involved; the iliac vessels and the retroperitoneal connective tissue usually escape; in two-fifths of cases Runge found pneumonia or pleurisy with small metastatic abscesses. Peritonitis and pyæmic metastases in the abdominal viscera and the joints have also been observed. In umbilical phlebitis the capsule of the liver and the liver itself become involved. Pericarditis, pleuritis, and other pyæmic complications are often present. The symptoms of such infection are often obscure. The umbilicus may become inflamed shortly after birth; the child has fever, is restless, holds its legs and thighs flexed, and often becomes jaundiced. Death may occur in convulsions, but occasionally recovery ensues. The treatment of umbilical septic infection is largely prophylactic: thorough antisepsis as regards the physician, nurse, and external genital organs of the patient, a suitable and cleanly dressing for the umbilicus, such as previously given, and scrupulous cleanliness while the cord is drying and becoming separated, render umbilical septic infection a rarity. If the child be too feeble to have the full bath for the first month of life, it is comparatively easy to allow the cord to remain undisturbed. Where, however, the child is bathed daily in the bath-tub, such of the cotton as may

become wet should be carefully removed, the cord repowdered, and fresh cotton applied.

The constitutional treatment of an infant suffering from septic infection through the umbilicus consists in the reduction of excessive fever by judicious sponging with warm or cool water, and the free administration of dilute alcohol and nourishing food. While quinine, if it can be taken, is a useful auxiliary, yet alcohol is the drug of most importance for such cases. Infants suffering from severe infections often bear strychnia as a stimulant better than might be expected from theoretical considerations only.

Erysipelas.

The micrococcus of Fehleisen may obtain an entrance at the umbilicus, and erysipelatous inflammation of the subcutaneous and cutaneous tissues may result. This process may go on even to the extent of gangrene and sloughing of the affected parts. Cases of mixed infection resembling erysipelas may develop, complicated by diphtheria, as in illustrative cases reported by J. Lewis Smith from the records of the New York Infant Asylum. The infection may localize itself in multiple abscesses beneath the skin, or, extending to the peritoneum, may cause death from acute peritonitis.

The treatment of erysipelatous infection of the umbilicus and surrounding parts consists in thorough applications locally of peroxide of hydrogen, boracic acid, or thymol solution, 1 : 1000. Following this, equal parts of iodoform and boracic acid may be employed freely. When pockets of pus form, they should be promptly opened with a knife or scissors and thoroughly douched with an antiseptic. The child's general strength must be assiduously supported by alcohol, food, and strychnia or quinine. As a stimulant in severe prostration, hypodermatic injections of camphor in oil, or administration, by the mouth, of freshly-made English breakfast tea, with rum, will be found of service in some cases.

Acute Peritonitis in the New-born.

Acute peritonitis occasionally arises very soon after birth as a complication of erysipelas or from some pathological process developing in the intestine. The communication in lymphatic channels between the intestine and the peritoneum seems unusually free in the infant, and as a result peritonitis rapidly supervenes. Cassell describes three interesting cases of this sort. Lorain, Quinquaud, and Silbermann have also reported illustrative cases of this disorder.

Tubercular and Typhoid Infection.

There exists certain ground for belief that the fœtus *in utero* may become infected by tubercle bacilli and also by the bacilli of typhoid. The first few days after birth may witness acute miliary tuberculosis or the development of a well-marked typhoid condition. As regards the former, the usual clinical signs of acute tuberculosis will be present: it must be remembered, however, that the infant rarely survives acute tuberculosis long enough for the formation of lung-cavities, and hence physical signs will often be lacking. The character of the fever, the rapid, uninterrupted course of the disorder, with increased dulness over the thorax, and the development of harsh and bronchial breathing, will usually enable the physician to make a diagnosis.

While treatment up to the present time has been practically unavailing, it is of interest to note the experiments of Pinard in using injections of the serum of dog's blood in these cases; in a series of twenty-one infants so treated he believes that benefit has resulted, the remedy seeming to act as a powerful tonic and stimulant.

The intra-uterine transmission of typhoid infection is well illustrated by a case recorded by Giglio. The presence of the typhoid germ was demonstrated in the tissues of an apparently normal fœtus and placenta born forty-six days after the beginning of typhoid fever in the mother.

The treatment of typhoid in the new-born is practically that in the adult, reference being had to the ease with which the infant is stimulated or depressed. The prognosis in such cases is exceedingly grave.

Inspiration Pneumonia.

In prolonged labor, complicated by a septic condition of the mother's birth-canal, premature inspiratory movements on the part of the fœtus may result in the inspiration of septic material: lobular septic pneumonia may result, and, occurring soon after birth, frequently proves rapidly fatal. Here, again, the efforts of the physician lie in prophylaxis, in delivering the patient promptly, and maintaining so far as possible an aseptic condition of the birth-canal until labor shall terminate.

Tetanus.

The infant may become infected with tetanus, and this disorder may appear in well-marked type from the sixth to the ninth day after birth. The tetanus bacillus usually finds its entrance at the unhealed umbilicus. Brieger has shown the specific cause of this disorder, and Beumer and Peiper have confirmed by clinical observation the identity of trismus and tetanus of the new-born with inoculative and wound tetanus. The mortality among infants is exceedingly large, and recovery is the rare exception. Appearing with symptoms of restlessness, night-terrors, and frequent cries, the child often becomes nauseated, has slight diarrhœa, and is then attacked by trismus. This, at first intermittent, finally becomes persistent, and develops into tetanic contractions of the entire body. Icterus is usually present. The disorder rarely lasts more than three or four days, the child perishing in collapse from twelve to twenty-four hours after the beginning of the convulsions. High temperature is usually present at the time of death. On post-mortem examination effusion of blood and serum in the cerebral tissues is frequently found. The violence of the convulsions may give rise to hæmorrhages into the muscular interspaces or into the tissues of the mediastinum.

In treatment hydrate of chloral and alcoholic stimulants give most prospects of relief. Holt has reported a case which recovered under the free use of bromide of potassium. A specific method of treatment by the injection of a substance similar to tuberculin has not, so far as we know, yet been employed in this disease. There would certainly seem to be reasons for testing its value.

Mastitis.

Mastitis in the new-born infant is to be regarded as a mild septic infection when the disorder comes to the point of suppuration and phlegmonous inflammation. The mammary glands of new-born children frequently become engorged and tender, but this condition subsides if the glands be let alone and

protected from external violence. When, however, infection occurs, pus-formation may take place and a septic mastitis may result. Such a complication, however, is exceedingly rare where antiseptic precautions are habitually taken in the treatment of labor cases. A distinction must be made clinically between simple engorgement of the breast and infection. In the former the child's temperature remains but little disturbed, its appetite is unimpaired, its rest remains practically as before. If the glands be carefully but gently washed with soap and water and bathed with bichloride, 1 : 10,000, a thin layer of absorbent cotton put over them, and a soft flannel bandage pinned snugly about the breast and supported over the shoulders by shoulder-straps or some other simple device, the glands may remain undisturbed for several days unless fever or restlessness indicates inflammation. On the other hand, where infection is present and pus has formed, prompt emptying of the gland by incision, with disinfection of the cavity, is indicated.

Infections of the Blood.

Profound alterations of the blood and nutritive cellular processes in the new-born, the probable result of infection at birth, have been described under various names by different observers.

Hecker and Von Buhl describe a disorder of infants born in asphyxia characterized by cyanosis, vomiting, icterus, profuse parenchymatous hæmorrhage, accompanied by acute fatty degeneration of visceral epithelium and heart-muscle. Phosphorus- and arsenic-poisoning were excluded in diagnosis, and the malady was named "acute fatty degeneration of the new-born," or Buhl's disease. Its pathology is not perfectly explained, but it may be classed among the infective disorders resulting in the extensive disintegration of the blood.

Acute hæmoglobinuria of the new-born was first clearly described by Winckel, who reported twenty-three cases of the disorder. It is characterized by swelling of Peyer's patches and the mesenteric glands, blackish-red staining of the pyramids of the kidneys, with stripes of hæmoglobin coloring, fatty degeneration of the liver and other viscera. Hæmatogenic icterus is present, the hæmoglobin being extensively changed into bilirubin. The urine is dark brown-reddish in color, contains hæmoglobin, epithelium, casts, and micrococci. Chemical poisons as a cause were excluded in diagnosis. The mothers showed no infection, the children were usually well developed. The mortality was 19 out of 23. The cause of the disorder is not clearly demonstrated. It is undoubtedly an infection which attacks the blood, resulting in hæmoglobinæmia. Prophylaxis and treatment, beyond the faithful employment of antiseptic precautions, are practically without avail.

Hæmatogenic jaundice, accompanied with multiple oozing of blood, has been recently described in an interesting paper by Partridge. In the case reported recovery ensued. In 1166 infants born at the Nursery and Child's Hospital, New York, 11 cases of hæmorrhage occurred, with a mortality of 75 per cent. At the Sloan Maternity Hospital, in 850 patients there were 14 cases; mortality over 60 per cent. No intelligent family history of bleeding was obtained.

Somewhat similar to these cases are those of the disorder known as

Melæna Neonatorum.

Infants dying with profuse hæmorrhage from the stomach and intestine have revealed an ulcer of the duodenum as a cause. In explaining these phenomena

Landau assigns as a cause thrombosis of the umbilical vein, resulting in embolism in the vessels of the stomach and duodenum. Persistence of the ductus arteriosus and hæmophilia also have been assigned as causes. Kundrat in examining Winckel's case found excessive secretion of the gastric juice, which had partly digested the mucosa of the intestine and occasioned hæmorrhage. In other cases bloody stools and vomiting of blood persisted for several days. Recovery occasionally ensues.

The prognosis is exceedingly grave, and treatment is practically unavailing. The milder preparations of iron may be given by the mouth, and hot or cold applied to the surface of the body as the condition of the child indicates. An abdominal compress may also be useful.

In closing this consideration of the infective disorders of the new-born we must again emphasize the fact that while we are not, in the present stage of our knowledge, in a position to particularize regarding the precise nature of the infective agent and its mode of operation, still, the fact remains reasonably proven that these cases result from some direct infection occurring just before or during birth. It remains, then, the positive duty of the practitioner to see to it that rigid asepsis—and, better, antisepsis—is employed regarding his hands and instruments, those of the attendant, and also the external organs of the patient. Ehrendorfer, writing upon this subject, draws attention to the dangers of infection, not only from mother to child, but from one child to another in hospital wards. The practice of putting a number of children in the same crib is objectionable, as is the custom of bathing a number of children in the same bath-tub, and, still worse, of using the same towels or cloths for a number of baths. From the moment of birth each infant should have its own toilet appliances, be they of the simplest description. In cleansing the child absorbent material which can be thrown away and not used a second time is preferable. Separate vessels for bathing the child's body and for washing the head and face are also desirable. In this way septic matter from the umbilicus is kept away from the mouth and eyes, and *vice versâ*. Nurses may be drilled to advantage in these niceties in the care of infants, which are not simple matters of æsthetic neatness, but are founded upon pathological facts.

PART II.

THE DIATHETIC DISEASES.

TUBERCULOSIS.

By WILLIAM OSLER, M. D.,

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I. General Etiology and Morbid Anatomy.

(*a*) Incidence of Tuberculosis in Infancy and Childhood.—Although it has long been known that, in the quaint language of Sir Thomas Browne, "consumptive and tabid roots sprout early," the appreciation of the widespread prevalence of tuberculosis in the early periods of life is due to recent observations. Extremely rare in the new-born and uncommon in the first three months of life, the cases increase rapidly throughout the latter half of the first year and in the second year. In the *crèche* of the Hôpital Tenon of Paris, in the year 1890, it is stated that more than 21 per cent. of the babies died of tuberculosis. Of 2576 autopsies on infants made at Kiel, Boltz found 424 cases of tuberculosis. The following table gives the proportions at different ages:

Infants born dead	0.0 per 100	From 2 to 3 years	33.0 per 100
From 0 to 4 weeks	0.0 " "	" 3 " 4 "	29.6 " "
" 5 " 10 "	0.0 " "	" 4 " 5 "	31.8 " "
" 3 " 5 months	8.6 " "	" 5 " 10 "	34.3 " "
" 6 " 12 "	18.3 " "	" 10 " 15 "	30.1 " "
" 1 " 2 years	26.8 " "		

The statistics of the late Professor Parrot embraced 219 cases in children under three years. Of these there were—

From 1 day to 3 months	23
" 3 to 6 months	35
" 6 " 12 "	53

giving a total of 111 under one year of age, and from one to two years, 108.

Of 500 autopsies in children at the Munich Pathological Institute, Müller found tuberculosis in 150. Of 527 infants dead in hospital of various diseases, tubercles were present in 314.

A set of combined autopsies on 2230 children gave 753 tuberculous and 1407 non-tuberculous. The ages of the tuberculous cases are thus grouped:

From birth to 1 month	10
Up to 2½ years	138
From 3 to 5 years	255
" 6 " 10 "	226
" 11 " 15 "	124

Analogous statistics are not, to my knowledge, available in this country, but the observations of Northrup at the New York Foundling Asylum show, at any rate, that the disease must prevail quite as extensively. From the third to the fifteenth year tuberculosis is also very frequent, and its manifestations in the glands, skin, and bones contribute a very considerable percentage of all cases in the out-patient departments of hospitals and in the special infirmaries for children's diseases.

The mortality, highest in the first year, sinks rapidly throughout childhood, to rise after puberty. Thus of 10,000 living, there die (U. S. Census, 1870) of tuberculosis in the first year 18.5; in the second, 10.5; in the third, 5.9; from the third to the fifth, 2.9; from the fifth to the tenth, 2; from the tenth to the fifteenth, 3.3. The Kiel mortality statistics (Heller) also show this in a striking manner: of 10,000 living, there died in the first year 245; in the second, 114; in the third, 76; from the third to the fifth, 34; from the fifth to the tenth, 14; from the tenth to the fifteenth, 16.

(*b*) The Bacillus Tuberculosis.—It is acknowledged by those most capable of expressing an opinion that the essential cause of tuberculosis is the organism discovered by Koch. The bacillus is a short, fine rod from 1 to 5 μ in length, and usually a little curved. In the sputum and in tuberculous tissue the bacilli are often in little clumps, or two lie crosswise at an acute angle.

For demonstrating the bacilli in sputa the following method will be found satisfactory: The thicker and more purulent parts of the sputum are picked out with a small sharp-pointed forceps and spread over the cover-glass, which is allowed to dry in the air and then passed three or four times through the flame. A few drops of Ziehl's solution of fuchsin—namely, distilled water 100 grams, carbolic-acid crystal 5 grams, alcohol 10 grams, fuchsin 1 gram—are placed upon the cover-glass, which is held over the flame until it begins to boil. The glass is then washed in water, and a few drops of Gabbet-Ernst's solution—namely, methylene blue 1 to 2 grams, 25 per cent. sulphuric acid 100 grams—are placed upon the glass and allowed to remain there for about a minute. The glass is then washed in water, and mounted either in water or, after drying between filter-paper, in oil or balsam. The tubercle bacilli are stained red, while the nuclei of the cells and any other bacteria are stained blue.

In sections the following method is pursued at the Pathological Laboratory of the Johns Hopkins Hospital: The tissues should be hardened in absolute alcohol and imbedded in celloidin. After the sections have been cut, the celloidin should be removed either with oil of cloves or with absolute alcohol and ether. After this they are passed through strong alcohol (to remove the oil or ether), and then placed in water previous to staining. The most satisfactory dye is the carbol-fuchsin solution of Ziehl. The sections are left for two hours at a temperature of 60° C. (or, if this be inconvenient, they may be stained for six or eight hours in the thermostat at 37° C., or for twenty-four hours at the room temperature). The tissue-elements and the bacilli are thus stained deeply in the fuchsin. A good decolorization solution is the ordinary acid alcohol of the laboratory (acid. hydrochloric. 1, aq. destill. 30, alcohol 70). The decolorizing process must be carefully watched, as too much of the dye may be easily extracted, the tubercle bacilli along with the tissue-elements losing their stain. It is best to remove the sections from the acid alcohol while they still retain a decided pink tint. A counter-stain is then used, the most desirable being a 2 per cent. aqueous solution of methylene blue. This removes all remaining fuchsin color from the tissue-elements and stains them a delicate blue. The tuber-

cle bacilli are stained a bright red. The sections are to be dehydrated in absolute alcohol, cleared in oil of cloves or preferably in xylol, and mounted in xylol balsam. It is best to examine with an oil-immersion lens, although if the bacilli are numerous they can readily be made out with a good high-power dry lens (Zeiss 3, or Leitz 7). Tubercle bacilli may be demonstrated in tissues by means of the rapid method used for staining them in sputum, but the results are very unsatisfactory, owing to the distortion of the tissues resulting from the action of the heat and the strong acids.

The bacillus is aërobic, and, although somewhat difficult to cultivate, may be grown on blood-serum, glycerin agar, or even on potato. The colonies form dry, grayish-white, scale-like masses. In the growth the bacillus forms certain soluble product or toxines, which, if introduced into the body, produce lesions similar to those induced by the bacilli themselves.

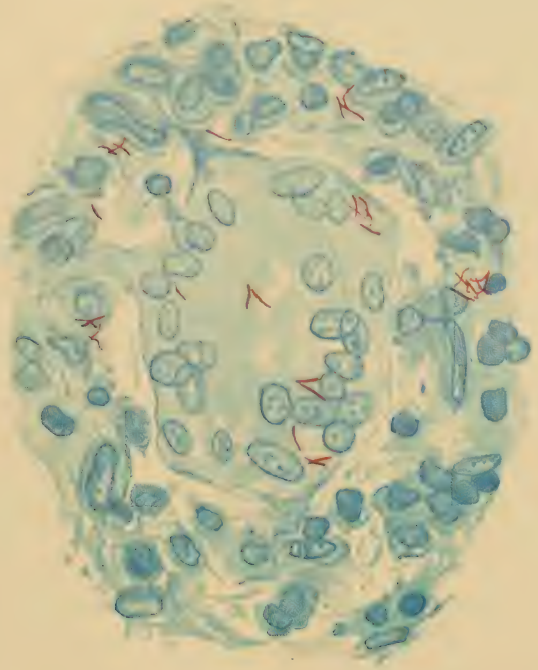
The bacilli are tolerably tenacious, and retain their virulence after freezing, desiccation, and salaison. It is stated that the bacilli have been found alive after burial of the subject for two years. The combined action of dryness and exposure to air is stated to diminish the virulence, but tuberculous sputum exposed to the air for from fifty to one hundred days still retains its virulence. The bacilli are rapidly killed in a few minutes by moist heat, as in boiling; dry heat is much less effectual. The bacilli are found in variable numbers in all tuberculous structures—the acute miliary nodule, the caseous, fibrous, and fibro-caseous nodules. They are most abundant in rapidly-growing tubercles and in the old ulcerous lesions of pulmonary tuberculosis. They are scanty, as a rule, in the more chronic tuberculous processes of glands and of bones, and in the lesions associated with extensive caseation. When not easily demonstrable by histological methods, inoculation in animals may alone determine the tuberculous nature of a structure.

Outside the body the bacillus has been shown to be a very widely-distributed organism, the number in any locality depending upon the number of cases of pulmonary tuberculosis and the carelessness or thoroughness with which the sputa of infected individuals is destroyed. In an ordinary case of pulmonary consumption countless millions are thrown out daily and scattered widely in the sputum dried as dust. Cornet found the dust of hospital wards and places occupied by tuberculous patients to be infective in a number of cases. Thus of 118 samples of dust from the wards of hospitals and rooms occupied by tuberculous individuals, 40 proved capable, when inoculated in animals, of producing tuberculosis. The infectiveness of the dust of the medical and surgical divisions of a hospital was found to be in the proportion of 76.6 to 12.5.

(*c*) Modes of Transmission.—(1) *Experimental Tuberculosis.*—Much of our knowledge of the disease has been derived from experiments, and we owe to Villemin the demonstration of the infective character of all tuberculous processes. The receptivity of animals varies very much: the rabbit and guinea-pig are particularly susceptible; dogs and cats are very resistant. Bovines are very susceptible, and one of the most important facts in the etiology of the disease is the frequency with which the disease occurs in them.

Subcutaneous inoculation of tuberculous material in a susceptible animal, as a rabbit or a guinea-pig, is followed in a short time by the production of a little nodular growth, which softens, and even ulcerates, and which in time may be absorbed. The corresponding lymph-glands swell, tubercles develop in them, and then caseate. The animal dies in from six weeks to three months. Tubercles are found in the lymph-glands, and there is, as a rule, general tuberculosis of the organs. The most satisfactory method is the inoculation of

PLATE IV.





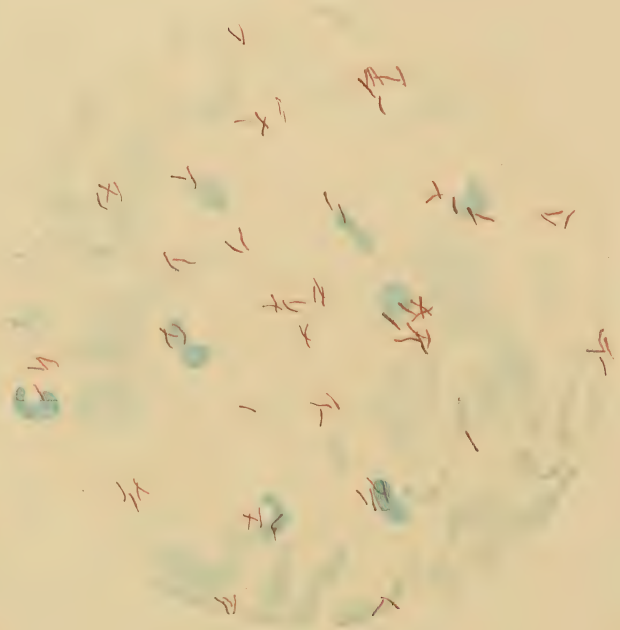


FIG. 1.—Section of a small fresh tubercle, showing large giant-cells surrounded by epithelioid cells. Tubercle bacilli are seen in the giant-cells and scattered in the tissue about it.

FIG. 2.—Section of tuberculous pleura under a low power, showing the exudate with groups of bacilli scattered in it.

FIG. 3.—Tubercle bacilli in sputum stained by the method given. The bacilli are more abundant than is usual.

material into the anterior chamber of the eye of the rabbit, as used by Cohnheim. The development of the tubercles, at first a local process, may be watched in the iris. There is afterward generalization, and the animal dies emaciated. In some instances in the rabbit and guinea-pig the lesion produced is entirely local and the animal recovers. If a culture of tubercle bacilli is injected into the veins, the animal dies, as a rule, in a shorter time, with the development of miliary granulations, particularly in the liver and in the spleen. If a larger quantity be injected, the animal may die of a profound infection before the tubercles become visible to the naked eye.

The transmission by inhalation is more difficult in animals, and the results of causing animals to breathe air charged with tubercle bacilli are discordant, but in some instances undoubted pulmonary infection and general tuberculosis have followed. Experimental infection through the digestive passages has also been demonstrated, particularly in the feeding of animals with the milk of tuberculous cows.

(2) *Hereditary Transmission.*—Current opinion on this point may be expressed as follows: While in a few rare cases tuberculosis is transmitted directly from parent to offspring, in the great majority of all cases the heredity does not relate to the transmission of the seed itself, but of a disposition of body, a type of tissue-soil favorable to the development of the disease in case of accidental infection.

Congenital tuberculosis has been observed in some six or eight cases. In the case of Charrin there was generalized tuberculosis in a fœtus seven and a half months old, the mother of which died of phthisis. In Berti's case the child, born at term of a phthisical mother, died on the ninth day, and two small cavities were found at the posterior border of the lower lobe of the right lung, which were shown microscopically to be tuberculous. In Merkel's case the tuberculous mother died two days after confinement. The child had tuberculosis of the palate and an abscess of the left trochanter major. In Jacobi's case the fœtus, born at the seventh month, had miliary granulations in the liver, peritoneum, spleen, and right pleura. In the case described by Sabouraud the child born of a tuberculous mother died on the eleventh day. The liver and spleen were tuberculous.

In all of the cases reported it was direct maternal heredity. The mode of transmission is not at all certain, but it is probably transmission through the placenta. Tuberculosis of the placenta is very rare. Lehman has recently reported an instance in a woman aged twenty-nine dead of acute tuberculosis in the eighth or ninth month of pregnancy. The fœtus was not affected, but on both surfaces of the placenta there were a few grayish nodules, which showed the characteristic structure of tubercle, with bacilli. It has been shown also that the placenta of a tuberculous woman proved infective; and, indeed, it is stated that the amniotic fluid of a tuberculous subject may produce the disease in a guinea-pig.

There are several experiments (Landouzy and Martin, Birch-Hirschfeld, and Armanni), which indicate that the virus may be present in the fœtus without the presence of actual tubercles, since they found that portions of the viscera of fœtuses born of tuberculous mothers were infective to guinea-pigs.

A modified view of this direct heredity is advocated by Baumgarten, who holds that the virus is directly transmitted, but remains latent, and does not develop until some time after birth. In support of this he quotes the large number of cases of tuberculosis in the early months, the figures illustrating which have already been given. He also lays great stress upon the occurrence of tuberculosis in the bones and the joints of children, regions to which the

bacilli would not be likely to be conveyed in accidental infection. This post-natal development he regards as analogous to *syphilis hereditaria tarda*, and he suggests that the actively growing tissues of the child restrain or inhibit the development of the germs.

There is no evidence to show that a tuberculous father can directly transmit the disease. The experimental evidence is also negative. Gärtner (whose recent article on "Heredity in Tuberculosis" is the most important contribution made to the subject of late years) found that in rabbits and guinea-pigs, with artificially induced tuberculosis of the testes, and whose semen contained bacilli, the embryos were never infected. On the other hand, of 65 female guinea-pigs which had consorted with the tuberculous bucks, 5 presented genital tuberculosis, and of 59 female rabbits under similar conditions 11 became infected.

In support of the view that tuberculosis is hereditary great stress is laid naturally on the frequency with which a history of the disease is met with in the parents. The estimates of various authors on this point vary from 10 to 50 per cent. Of 427 cases at the Johns Hopkins Hospital, there were only 53 in which the mother was affected, 52 in which the father had had tuberculosis, and 105 in which sister or brother had had the disease. The fact that the children and relatives of tuberculous individuals are more directly exposed to contagion than other individuals renders it difficult, as Fagge remarks, to draw a clear line between heredity and accidental infection.

(3) *Inoculation.*—This is not very common in man, as the skin does not offer a very suitable soil for the development of the tubercle bacilli. This mode of infection is, however, seen in persons whose occupations bring them in contact with dead bodies and animal products. Demonstrators of anatomy are particularly subject to a local tubercle on the finger or back of the hand—the so-called post-mortem wart, *verruca necrogenica*, the "lichen" tubercle of the Germans. Only in very exceptional instances is this followed by serious results. Cases have been reported of infection from the bite of a tuberculous patient, inoculation from a cut by a broken spit-cup and the puncture of a hypodermic needle. There is no reliable observation of the transmission of tuberculosis by vaccination. In the performance of the rite of circumcision children have been inoculated, the infection in these cases being associated with disease in the operator, and occurs in connection with the habit of cleansing the wound by suction.

(4) *Transmission by Inhalation.*—The expired air of tuberculous patients is harmless, but the sputa, dried and widely diffused in the form of dust, constitute one important medium of transmission in the disease. The investigations of Cornet have shown the greater infectiveness of the dust of localities frequented by patients with pulmonary tuberculosis. The frequency with which the disease is met with in the lungs and in the bronchial glands finds here its explanation.

In institutions the residents of which are restricted in the matter of fresh air and exercise, as in jails and convents, the death-rate from tuberculosis is very much higher than in the general population. Cornet found that in some of the religious communities more than three-fourths of the deaths were due to this disease. The mortality in prisons from tuberculosis is from 40 to 50 per cent., while in the general community it is not more than 15 per cent. Flick has brought forward evidence to show that the distribution of tuberculosis in one of the wards of the city of Philadelphia is more particularly with certain houses in which individuals have died of this disease. There are also some striking local epidemics of tuberculosis: thus Marfan gives an instance of a

place confined and badly ventilated, occupied by twenty-two employees, who were joined in 1878 by two consumptives, who for several years coughed and spat about the floor indiscriminately. The employees arrived at an early hour and breathed the air charged with the dust raised by the morning cleaning. Between 1884 and 1889 thirteen of these persons fell victims to tuberculosis.

Against these facts, however, are the statements that at hospitals for consumptives, as at Brompton, in London, the doctors and nurses are rarely attacked. Dettweiler claims that at his institution in Falkenstein no case of tuberculosis has been contracted. On the other hand, Marfan states that in the Paris hospitals tuberculosis is extremely frequent in the attendants and decimates the lay contingent. At the Hospital Necker half of the attendants are attacked with phthisis, and he notes as a significant fact that it is particularly the attendants in the medical wards.

The danger is enhanced when the contact is particularly intimate, as between a tuberculous mother and her child or between man and wife. In the latter case there are figures which indicate that contagion is not at all infrequent.

(5) *Transmission by the Food.*—Experiments have shown that infection may be communicated by ingestion of tuberculous material, and one of the most important problems relates to infection with the milk of tuberculous cows. Experimentally, it has been conclusively demonstrated that such milk is infective, even when the disease is localized in the lungs of the animal, and that it is not necessary that the udder should be diseased. Ernst has shown that the bacilli may be present in the milk when there is no tuberculous mammitis. The danger of infection from this source in children is very urgent, and systematic sanitary inspection should be made of the cows, and, if necessary, inoculation experiments made with the milk.

The percentage of tuberculous animals in the dairy-stables of our cities is very much larger than has been supposed. The figures in this country for large numbers are not available. It has been stated that from 10 to 15 per cent. of the dairy stock in the Eastern States is tuberculous. This is probably a low estimate.

The virulence is retained in the cream and in the butter. Other conditions than the presence of the bacilli in the milk are probably necessary for infection, and, fortunately, all children who drink tuberculous milk do not become contaminated. In some instances the gastric juice may destroy the bacilli; in others, conditions of the tissues may not be favorable to the development of the seed. Experimentally it has been shown that lesion of the intestines itself is not necessary, and infection of the mesenteric glands may take place through a normal mucosa. Possibly the great frequency of mesenteric tuberculosis in children finds here its explanation. In 127 cases of fatal tuberculosis in children noted by Woodhead these glands were involved in 100. It is not definitely determined whether the milk of a tuberculous woman is virulent.

Infection by meat is probably very much more rare. When the tuberculosis is generalized in the internal organs the flesh should be confiscated. The virulence, however, is only marked when the disease is very extensive. It has been shown that the flesh of tuberculous subjects is infective to guinea-pigs. Nocard, however, in a series of experiments found that the juices of the muscle of twenty-one cases with general tuberculosis, when injected into the peritoneum of guinea-pigs, only once produced tuberculosis.

(*d*) Conditions influencing Infection.—(1) *General.*—These, dealing specially with the environment of individuals, explain in a great measure the

frequency of the disease in certain localities. Thus one of the most important is residence in the large centres in which many people are crowded together. The death-rate from tuberculosis is very much higher in towns than in the country, and a very considerable share of the high infant mortality of cities is to be attributed to it. Not only is the air of the large towns less pure, but the chances are very much greater that the dust, blown in all directions, has with it the germs of the disease. The inhalation of impure air in certain occupations, which in adults is an important predisposing factor in pulmonary tuberculosis, does not prevail to any special extent in children. Climate in itself does not influence the conditions materially, but, as a rule, the disease is more common in the temperate regions, largely because in these are found the largest collection of human beings. Soil and locality have an important influence, cold and dampness increasing the personal liability by favoring the development of catarrhal affections. There are fewer cases of tuberculosis and fewer foci of infection in regions such as the Alps and in elevated plateaux as in Mexico, but altitude itself does not confer immunity, and there are many mountainous regions in which the inhabitants are much affected by tuberculosis.

More important than these are the factors relating to personal environment, as of the dwellings. The constant breathing of a vitiated air, as in the small crowded rooms in the tenements and narrow alleys of our large cities, and the absence of sunlight, are two of the most important predisposing elements in tuberculosis in children. These influence infection in two ways: first, by favoring the distribution of the bacilli; and, second, by lowering the nutrition of the individual and leading to conditions favoring the entrance of the bacilli to, or their development in, the body.

(2) *Individual Predisposition.*—From the time of Hippocrates it has been thought that there was a certain conformation of body which rendered an individual more prone to the disease. His words are: "The form of body peculiar to subjects of phthisical complaints was the smooth, the whitish, that resembling the lentil; the reddish, the blue-eyed, the leuco-phlegmatic; and that with the scapulæ having the appearance of wings." In children it may be said that the build and type such as here described is certainly more prone to tuberculous affections. Two types of conformation have long been recognized as predisposing in some way to infection; the *tuberculous*, with bright eyes, oval face, thin skin, and long thin bones, and the *scrofulous*, with a heavy figure, thick lips and hands, opaque skin, and large thick bones. But, as in adults, well-developed, healthy infants and children may become subject to the disease. In addition to the conformation of the chest, the respiratory capacity, the relation between the volume of the lung and of the heart, a relatively small heart with narrow arteries, and a pulmonary artery relatively wider than the aorta (Beneke), and relatively large-sized viscera, have all been brought forward as causes predisposing to tuberculosis.

Among others which may be mentioned is race: the negro seems more liable to the disease than the white races, and it is stated that the Hebrews possess a relative immunity.

More important in children are the local conditions influencing infection. Acute and chronic catarrhal troubles of the throat and upper air-passages, and of the lung, undoubtedly favor infection, either by allowing the freer entrance of the germs or by weakening the powers of resistance. The infectious diseases, particularly whooping-cough, measles, and influenza, act probably in this way, while small-pox, typhoid fever, and syphilis influence the conditions rather by reducing the power of resistance. In institutions the frequency with which tuberculosis follows the infectious disorders is very striking.

Of local affections of the lungs which predispose to tuberculosis, hæmoptysis, which was regarded as an important cause, is now thought to be an indication rather of the existence of the disease. Such disorders as dilatation of the bronchi and pleurisy also heighten the liability to infection, though in the latter case many of the instances believed to be simple are in reality from the outset tuberculous.

The subjects of congenital or acquired contraction of the orifice of the pulmonary artery usually, as is well known, die of tuberculosis. Prior to the development of the disease many subjects show a marked anæmia, and unquestionably chlorosis offers favoring conditions for the development of this affection. Diseases of the stomach and intestines, particularly chronic entero-colitis, increase the susceptibility to infection.

Blows and contusions favor in some way the development of tuberculosis, particularly in children, in whom spinal caries and hip disease may follow an injury; less often does trauma play any part in pulmonary tuberculosis. Here, too, may be mentioned the favoring influence of operation: resection of a tuberculous joint is occasionally followed by an acute infection.

With reference to infection and the conditions which influence it the following may be stated:

(*a*) In a few cases the disease is directly transmitted from the mother, and appears in the child at birth.

(*b*) The primary tuberculosis of the bones, joints, kidney, spleen, liver, etc. of early youth is very possibly associated with a fœtal hæmatogenous infection (Baumgarten, Gärtner).

(*c*) Direct paternal transmission has not been proved, and experimental evidence is strongly against it.

(*d*) In a large proportion of cases the infection is post-fœtal—through the lungs, intestines, or skin.

(*e*) Heredity influences the *soil*. All are *tuberculizable*, to use a French expression, and very many of us actually become infected. Whether or not the *seed* develops depends, firstly, upon the character of the tissue-soil; and secondly, upon the existence of special favoring circumstances.

(*f*) Immunity, a relative condition, enjoyed chiefly in consequence of inherited tissue-resistance, is lessened by all circumstances which depress nutrition, such as bad air, bad food, and imperfect hygienic surroundings. Next to the germ, a vulnerability of tissue, however brought about, whether congenital or acquired, is the most important factor in the etiology of the disease.

(3) *The Relations of Tuberculosis and Scrofula.*—The lesions known as scrofulous are tuberculous, and due to the development of the *bacillus tuberculosis*, so that the term scrofula is now almost, and may well be entirely, abandoned. Though the so-called scrofulous lesions of glands and bones and skin are bacillary in origin, yet it has been shown that their virulence is not so extreme as that of the tuberculous products in the viscera, the latter, according to Arloing, killing, when injected, both guinea-pigs and rabbits, the former only guinea-pigs. This corresponds with the more protracted course and the more favorable termination of the so-called scrofulous affections. It has been suggested that the scrofulo-tuberculous manifestations are caused by an attenuated virus. An attempt has been made by writers, particularly Marfan, to show that the scrofulo-tuberculous lesions, when recovered from, confer a sort of immunity to pulmonary tuberculosis, but the evidence for this is not yet very strong.

(*e*) Anatomical Changes produced by the Tubercle Bacilli.—The lesions induced by the bacilli are in the form of small nodules which, fused

together, may form large infiltrated areas, so that a distinction is often made between the nodular and the diffusely infiltrated varieties. The studies of Baumgarten and others have enabled us to follow accurately the primary changes induced by the bacillus. These are—

(1) The mutiplication of the fixed tissue-elements by a process of karyokinesis. The cells of the vascular epithelium, of the ordinary epithelium, and of the connective tissue proliferate, and gradually there is produced from them the large, rounded, cuboidal, or polygonal cells with vesicular nuclei—the so-called *epithelioid* cells—inside some of which the bacilli are seen. This reaction of the fixed elements of the tissue would appear to be the primary effect.

(2) Leucocytes, chiefly polynuclear, migrate, and accumulate about the focus of infection. These form the lymphoid cells which were formerly thought to be so characteristic of the tubercle. They do not, however, undergo subdivision. Some believe that they attack and destroy the bacilli. There would appear to be successive invasions of leucocytes at the focus of irritation, and many of them undergo rapid destruction. It is stated, too, that later, as the little tubercle grows, the leucocytes which surround it are of the mononuclear form, or lymphocytes, and that these persist and do not undergo the rapid degeneration of the polynuclear forms.

(3) A reticulum of fibres is formed in the tubercle by the fibrillation and rarefaction of the connective-tissue matrix, most apparent, as a rule, at the margins of the growth.

(4) In some, but not in all, tubercles giant-cells are formed by an increase in the protoplasm and in the nuclei of an individual cell, or possibly by the fusion of several cells. The bacilli are usually, but not always, seen in the giant-cells. There seems indeed to be an antagonism between the number and virulence of the bacilli and the giant-cells: thus in joint and gland tuberculosis and in lupus, in which the former are scanty, the latter are abundant; while in miliary tubercles, and, as a rule, in all lesions in which the bacilli are abundant, the giant-cells are scanty.

The tuberculous nodule thus formed may undergo necrosis and caseation, or may gradually be converted into a connective-tissue mass. Caseation begins at the central part of the growth, and appears to be owing to the direct action of the bacilli. The cells undergo coagulation necrosis, lose their outline, become irregular, and are finally converted into a homogeneous, structureless material in which the cells are no longer distinguishable, and which no longer takes the stain. As this process extends involving several nodular tubercles, they are gradually converted into uniform yellowish-gray masses. No blood-vessels are found in the central portion, but the bacilli are usually abundant. By the union of many of the nodular tubercles large masses may be formed which may undergo either (1) softening or liquefaction with the formation of cavities; (2) fibroid limitation, leading ultimately to encapsulation; (3) in the older caseous masses, particularly when encapsulated, lime salts may be deposited (calcification); and (4) sclerosis. There is necrosis of the tissue-elements in the centre, gradual hyaline transformation, with great increase in the fibrous reticulum, so that the tubercle is ultimately converted into a firm, hard structure. Sometimes increase in the fibrillation and caseation go on together, with the production of fibro-caseous tubercle.

Diffuse Infiltrated Tubercle.—It was formerly thought that the products of any simple inflammation might become caseous, and the identity of the caseous pneumonia and of scrofulous lesions with tubercle, which Morton (1685) maintained, and which Laennec laid down as a fundamental proposition, was for a long time disputed, particularly by Virchow. Now, the researches of Koch

have demonstrated that these infiltrated caseous lesions are definitely tuberculous.

Infiltrated tubercle results from the fusion of many small nodular foci, too small sometimes to be visible to the naked eye. Histologically, however—in the lungs, for instance—they may be seen to be composed of scattered centres surrounded by zones in which the air-cells are filled with leucocytes and the products of the proliferation of the alveolar epithelium. Under the influence of the bacilli caseation takes place, usually in small groups of lobules, but occasionally in an entire lobe, or it may be throughout the greater part of a lung. There is really no essential difference between the nodular and the infiltrated tubercle.

Secondary inflammatory processes accompany the growth and development of tubercle: (1) The exudation of leucocytes and serum about the primary growth is in reality an inflammation, which varies with varying conditions, and which may be limited or very extensive. For example, about the tubercles in the lungs there is always inflammation of the alveoli with infiltration and proliferation of the connective-tissue elements of the septa, and changes in the blood- and lymph-vessels.

(2) The bacilli themselves may induce suppuration, as in joint and bone tuberculosis; experimentally, the products of the growth of the tubercle bacilli, particularly Koch's tuberculin, produce an active suppuration. In tuberculosis of the lungs, as well as in other regions, the suppuration is largely the result of a mixed infection, and is due to pus-organisms.

(3) A slow, reactive inflammation occurs about many tubercles, resulting in the formation of a cicatricial connective tissue, limiting and restricting their growth, and constituting, in reality, the important conservative and healing element in the disease.

II. Generalized Forms of Tuberculosis.

(1) Acute Miliary Tuberculosis.

Forms of tuberculous infection running a rapid course are decidedly more common in infants and children than in adults. Practically, there is always a focus of local disease in a bronchial or mesenteric gland, a joint, or on the skin, or in superficial lymph-glands. In a few rare instances a miliary tuberculosis is encountered in which caseous foci cannot be discovered. The picture may be either that of an acute infection without definite local manifestations, or of an intense infection with pronounced symptoms pointing to involvement of the meninges of the brain, the lungs, or the serous membranes. In children there is no hard-and-fast line to be drawn between the acute forms in which miliary granulations occur throughout all the organs, and in which the clinical course is from three to six or eight weeks, and forms in which throughout the various organs there are coarser, larger grayish-yellow tubercles, and in which the clinical course is of more subacute character, lasting from eight to twelve or even sixteen weeks. As in the adult, the cases may be divided for convenience into three groups, as the symptoms are those of a general infection, simulating very often typhoid fever, or those of an acute meningitis or of an acute affection of the lungs. These cerebral, general, and pulmonary types cover a majority of the cases. There may be mentioned, in addition, an acute affection, occurring in children the subjects of a local tuberculous process, in which, with the symptoms of a profound infection, there is no general miliary tuberculosis. This form, which has been described by several French writers as the *fièvre*

infectieuse tuberculeuse suraiguë, is not generally recognized, but the cases described by Landouzy and others presented quite minor tuberculous lesions of the lungs or of other organs, with the clinical symptoms of very intense infection, the severity of which was out of all proportion to the local lesion and to the number of miliary granulations found throughout the body. It is thought to be due to the action of the tuberculous toxines.

The acute tuberculous meningitis will be described separately. We shall here speak only of the typhoid and of the pulmonary types.

Typhoid Type.—The onset is usually insidious, and commonly there has been an indisposition or slight cough, but prior to the fever the child may have been in good health. The fever is noticed in the afternoon or evening, and with it there is loss of appetite, and the child loses in weight and is listless and not inclined to play. A bronchial cough is by no means uncommon, but it is to be remembered that the disease may set in quite abruptly in a child believed to be in good health. Within a week, or even earlier, the child takes to bed, and the symptoms of an infection are well pronounced. The tongue is white and furred. The abdomen is distended, sometimes painful on pressure, and there may be diarrhœa. The spleen is usually enlarged, and can be readily felt. The liver may be also distinctly swollen. The gastro-intestinal trouble with the continued fever may be strongly suggestive of typhoid fever, but rose-spots are not detected. There are usually some symptoms pointing to the involvement of the bronchi or the lungs, and the respirations are hurried, only, however, in proportion to the fever, and the physical signs indicate rather a catarrh of the larger than of the smaller tubes; there is no dulness. There are headache, delirium, particularly at night, and sometimes marked hyperæsthesia of the skin. Albuminuria is often present, and there may be complete suppression of urine. The fever varies greatly in intensity, but usually has not the regularity of typhoid, and the daily exacerbations are more marked. It may rise to 104° and 105° F. On the other hand, there are cases in which the fever is moderate, not more than 101° or 102°, and very rarely there may be no fever. There are also instances in which there have been rigors throughout the course of the disease. The condition of the child becomes aggravated, and with a dry tongue, delirium, unconsciousness, distended abdomen, and swollen spleen, the similarity to typhoid fever is very close. The course is extremely variable, and while death may occur at the end of the second or beginning of the third week, in other cases the disease is prolonged to five or six weeks. In the more protracted cases definite local signs are met with; thus, with an increase in the dyspnœa and cough bronchitis of the smaller tubes is found, and patches of consolidation at the bases, so that aëration is very defective. The eruption of tubercles on the meninges may intensify the cerebral manifestations, and there may be from the outset severe headache, with a gradual and progressive coma, dilated pupils, and sometimes strabismus.

Pulmonary Type.—The clinical features are of an intense capillary bronchitis (broncho-pneumonia). This, the more common variety, is very often mistaken at its onset, and even throughout the course, for simple bronchopneumonia. The onset may be abrupt, and even with a chill, but, as a rule, the child has been failing in health or is at the time convalescing from some acute illness or is the subject of an acute naso-pharyngeal catarrh. The fever is high, and may reach from 103° to 105°; the pulse is rapid, from 130 to 140. The respiratory symptoms are marked. At first the shortness of breath is slight and proportionate to the fever, but gradually it increases, and the respirations may be from 60 to 70 per minute. The cough is frequent, dry, and very troublesome. As the dyspnœa becomes more marked the color of the face changes,

and there is slight cyanosis. Though the fever is high and the symptoms grave, there are rarely severe cerebral manifestations. There may be slight diarrhœa, but the abdomen is not specially distended; the spleen is easily palpable. The whole clinical picture is that of an acute broncho-pneumonia. The physical examination shows hurried respiration, and there may be retraction of the lower zone of the thorax; the percussion note is clear, even hyperresonant, and auscultation at first shows signs of a general bronchial catarrh, chiefly of the smaller tubes. Subsequently, as the case progresses, there are areas in which the resonance is higher in pitch or even tympanitic, and in places distinct blowing breathing may be heard, or even the signs suggestive of cavity.

The course of the disease in this type is much more rapid, and the child may die at the end of a week, or even earlier, with the signs of an acute suffocative catarrh—more commonly in from ten to twelve or fourteen days, usually from a progressively advancing asphyxia.

Diagnosis.—The diagnosis of acute tuberculosis in children may be very easy or beset with the greatest difficulties. The family history should be taken into account; the surroundings of the case, particularly whether there have been instances of tuberculosis in the same house or occupying the same room. Much more important is the previous history and personal condition of the patient. Inquiries should be made about whooping-cough and measles, diseases not infrequently followed by acute tuberculosis. Sometimes a history of failing health or of protracted catarrh may be obtained. The most evident cases are those in which there are signs of local glandular or bone tuberculosis. Sometimes the acute affection follows an operation on the tuberculous glands of the neck or the opening of a joint abscess, or even of a so-called cold abscess, or, in very rare instances, the tapping of a pleural effusion. In the typhoid type, when the features are well developed, the simulation of ordinary enteric fever may be extremely close. Here, if from the outset a careful temperature record be kept, it will usually be found that the fever is much more irregular in tuberculosis, and early in the disease there may be quite marked morning remissions. As noted before, in a few instances the temperature may be low, even subnormal, in the morning. The general features of infection are much the same in both diseases. The absence of typhoid rash, unless it is there, which is usually present in children, and very distinctive, is a most important negative sign. Expectoration is rarely obtained, but should the child vomit, sputa should be looked for in the vomitus, since it sometimes happens that an acute miliary tuberculosis takes its origin in a small focus of disease in one lung, from which tubercle bacilli may reach the sputum.

The examination of the urine is important, but Ehrlich's reaction is present as frequently in acute tuberculosis as in typhoid fever. Pus in the urine should be carefully examined for bacilli, since instances of general infection have resulted from urogenital tuberculosis.

The profound infection associated with malignant endocarditis may simulate that of acute tuberculosis. The special heart-signs, if present, and embolic features, would be important distinguishing marks. The diagnosis of the catarrhal or broncho-pneumonic type will be more fully considered when speaking of the acute tuberculous broncho-pneumonia of infants.

Prognosis.—The prognosis is always unfavorable. Here, however, may be mentioned a type of acute tuberculosis recognized by Empis, Landouzy, and others, which they call *typho-tuberculose* or *typho-bacillose*, and which may be either the first manifestation of the invasion of the organism with the bacilli or the expression of an acute, but aborted, tuberculosis, following some local tuberculous process. The clinical aspect is really that of typhoid fever, and

the temperature curve would not appear to give any definite criterion. Unless, in fact, there is some local tuberculous focus, I do not see how this form can be recognized, and many of the cases reported by Aviragnet in his monograph are not at all convincing. That there may be, however, either early in a tuberculosis, or as a secondary event in a local process, an infection of the system with the toxines is extremely likely. In adults it is not very uncommon to find a tuberculous focus completely overlooked in a general infection believed to be typhoid fever, and in which the secondary development of miliary granulations seems scarcely sufficient to account for all the symptoms.

(2) Chronic Diffuse Tuberculosis.

This, one of the most common forms of tuberculosis in children, is characterized anatomically by the gradual development of tubercles in many different parts of the body : they are not, however, the miliary granulations of the acute tuberculosis, but coarse, grayish-yellow tuberculous masses, varying in size from a pea to a walnut. In the lungs, for instance, there are caseous tubercles of all sizes, areas of caseous broncho-pneumonia, some of which have undergone softening; but cavities are not common except in children above four or five. The bronchial glands are often greatly enlarged and caseous, and sometimes present abscesses. The abdominal organs show extensive tuberculosis. The spleen is greatly enlarged, and on section presents numerous grayish-yellow tuberculous masses, varying in size from 2 to 10 mm. The liver is enlarged and may show miliary tubercles on the capsule, but in many instances there are coarser yellowish-gray masses which have developed about the bile-capillaries, and which, having softened in the centre, present a yellowish-green bile-stained pus. The small intestines may show tuberculous ulceration to a greater or less extent. The mesenteric glands are usually enlarged and caseous. The kidneys may show coarse tubercles, sometimes an intense tuberculous pyelitis. In the brain there may be either an acute terminal meningitis or there are coarse tuberculous nodules scattered throughout the substance, particularly in the cerebellum. The chronic diffuse tuberculosis is much more frequent in infants than in children above the age of two. The symptoms are those of a progressive enfeeblement of the nutrition, as a rule *without fever*, and with manifestations in different organs varying with the degree of tuberculization. The affection may set in acutely as a bronchitis or a broncho-pneumonia, the symptoms of which gradually subside. Very often the condition follows whooping-cough, measles, or acute gastro-intestinal catarrh. Less frequently it is insidious, and the child presents simply progressive failure in health. The appearance of the child is that of marked cachexia. It is thin; the skin is loose and pale, sometimes covered with fine scales, and occasionally pigmented. The eyes are large, and the expression often bright and animated. The thorax is thin, the ribs readily noted, and there may or may not be the signs of coexisting rickets. The abdomen is usually tumefied, and both the liver and spleen are enlarged. When the abdominal features are marked, the clinical picture is that really of some cases formerly described as tabes mesenterica. The superficial glands may be enlarged and hard. Cough may be present, usually dry, and very rarely there is dyspnœa. The physical signs thoroughout the lungs are either dulness in the interscapular regions or scattered areas of defective resonance with bronchial râles and blowing breathing. The appetite is poor, the digestion feeble, vomiting is frequent, and diarrhœa is common. Not only may there be no fever, but the temperature may even be subnormal. Death usually results from some complication, either a secondary invasion of pneumococci or streptococci, or an acute meningitis.

The diagnosis may present difficulties if one does not constantly bear in mind, in the first place, the frequency of tuberculosis in infants, particularly in institutions; and, secondly, the fact that this diffuse form, which is very common, may pursue its course without fever, and only perhaps toward the close show signs of active disease, now of the meninges, now of the lungs, or, again, of the intestines. This cachexia of the chronic diffuse tuberculosis of infants must be distinguished from that of rickets, of chronic gastro-intestinal catarrh, and of syphilis. In rickets the changes in the bones and cartilages, in athrepsia the marked gastro-intestinal disturbance, and the, as a rule, more enfeebled and senile look of the child, serve as distinguishing features. The absence of enlargement of the spleen and liver or of the lymph-glands is an important negative sign. A greater difficulty exists in distinguishing some of the cases of profound syphilitic cachexia, as here the superficial glands may be enlarged and the spleen and liver hypertrophied; but, on the other hand, the history, the facies, the skin-rashes, rhagades, and, above all, the prompt improvement under antisyphilitic treatment, are important points of differentiation.

III. Localized Tuberculosis.

(1) Tuberculosis of the Lymph-glands.

(*a*) Tuberculous Polyadenitis.—The lymphatic system may be the chief seat of the disease, and the glands, internal and external, or the lymph-sacs (serous surfaces), may present advanced tuberculosis without much involvement of the viscera or other parts. This is more often the case than we have heretofore supposed. In some instances of general tuberculous infection in young children there may be what Legroux calls micro-polyadenopathy, which in doubtful cases may give an important diagnostic hint. More recently Lesage and Pascal have described cases in children in which there was progressive involvement of the lymphatic glands, usually at first those of the groin, then those of the axilla, and lastly the cervical and internal groups. They regard the affection in some of the cases as due to cutaneous tuberculosis; in others they believe the disease to be congenital. The symptoms of this form of generalized enlargement of the superficial lymph-glands are progressive cachexia without much fever and without signs of disease of the lungs or of the abdominal organs, and frequently a ravenous appetite.

The cases must be carefully distinguished from the general slight enlargement of the lymph-glands in syphilis, and from the rare cases of Hodgkin's disease in children, in which, however, the enlargement is much greater and the involvement of one group is generally much more marked. It must not be supposed, however, that every case of general moderate enlargement of the superficial lymph-glands in children is due either to tuberculosis, syphilis, or Hodgkin's disease. Following the infectious fevers, and associated with chronic catarrh of the upper air-passages, I have seen on more than one occasion enlargement of the glands of the neck, of the groin, and of the axillæ—a condition of the superficial lymph-apparatus comparable to the swelling of the Peyer's follicles and of the mesenteric glands found so frequently in children dead of one of the infectious diseases, or, in fact, of any prolonged illness.

(*b*) Cervical Adenitis.—The drainage-areas of the lymphatic glands of the neck embrace the superficial and deep structures of the head and neck.

The most important groups are the superficial cervical, beneath the platysma, which drains the side of the head and neck and face and external ear, and the deep cervical along the carotid sheath, which drains the mouth, the tonsils, palate, pharynx, and larynx. In addition there are the submaxillary and suprahyoid groups draining the lower gums, the front of the mouth and tongue, and the chin and lower lips.

Tuberculous adenitis of the glands of the neck, so extremely common, which fortunately often remains a local and curable affection, was regarded as one of the most typical and characteristic manifestations of scrofula. Cornet's observations upon the presence of tubercle bacilli in the dust of cities and of rooms show how widely spread the virus is, and how liable we are in crowded cities to inhale, and even to swallow, bacilli with the dust. Whether the bacilli are capable of passing through the healthy mucous membrane is perhaps doubtful, though there are experiments which would seem to prove the liability of infection through the healthy mucous membrane of the intestines. More probably the slight catarrhal troubles about the naso-pharynx, so frequent in children, open, as one may say, the portals and allow the bacilli to reach the lymph-glands. Preliminary irritation and enlargement of the glands in eczema of the scalp and in sore throat in children may weaken the powers of resistance. Here, no doubt, if the tissue-soil be unfavorable, they may exert no influence whatever, but with that vulnerability of tissue, regarded by former writers as the characteristic feature of scrofula, the bacilli find a suitable nidus, and a local tuberculosis is the result—a process characterized usually by extreme chronicity.

The glands may enlarge rapidly at first and become soft and painful; more commonly, they swell slowly, and can be felt as firm rounded masses freely movable beneath the skin. They may gradually subside and undergo spontaneous healing. In other instances the glands increase, areas of softening are found, the process involves the skin overlying the gland, which becomes red, and finally ulcerates, discharging a cheesy matter and a thin watery sero-pus. The sore thus left is very indolent, does not tend to heal; the skin about it is livid and undermined. Many of the glands may suppurate in this way, and when healing ultimately takes place the sides of the neck are disfigured by irregular, unsightly scars. In the neck of young or old these are usually a certain sign of healed tuberculosis.

It is to be borne in mind that involvement of the cervical glands may be due to extension of tuberculous processes from the axillary glands or even from carious cervical vertebræ. When the glands are large and growing actively there is fever; death very rarely follows, and even aggravated cases in children may recover. In some instances the general nutrition is very slightly disturbed. Tuberculous adenitis of the cervical or axillary groups may precede the development of tuberculosis of the pleura or of the lung.

(*c*) Tracheo-bronchial glands.—Within the thorax the groups of lymph-glands are of great importance. The sternal are placed along the course of the internal mammary vessels; the intercostal along the heads of the ribs, and sometimes extending outward; the anterior mediastinal group between the lower part of the sternum and the pericardium; the cardiac group in the inter-pleural space about the arch of the aorta; and, lastly, the tracheal glands on either side of the windpipe, and the bronchial proper, continuous with them, which surround the main bronchi and pass deeply in the hilus of the lung. There are also glands in the posterior mediastinum along the thoracic aorta and œsophagus. Tuberculosis of the tracheo-bronchial glands is extremely

common. Observations of Loomis (Jr.) show even that in apparently normal glands bacilli may be present and the gland-tissue infective. Certainly in a very large proportion of all cases of tuberculosis in children it would appear that the first infection was in these structures, while common experience shows, contrary to the so-called law formulated by Parrot, that the glands may be involved without any local lesion in the lungs. Of 125 cases examined by Northrup, the bronchial glands were tuberculous in every case; 42 had cheesy masses in the bronchial lymph-nodes only, with recent tubercles in the lungs and elsewhere; in 13, it was limited to the bronchial glands alone. The glands may present gray miliary tubercles, large, unpigmented, cheesy areas, foci of softening with suppuration, or old calcified masses. In the long-standing cases there is much sclerosis and pigmentation. The different groups may be very differently involved; thus the tracheal may be much affected without great involvement of the bronchial nodes proper. More commonly all the glands are involved, and very often those deep in the hilus of the lung form large caseous masses uniformly surrounding the main bronchus and its divisions, and penetrating deeply between the lobes of the lung. When the glands suppurate the abscesses may perforate in different directions. The effects of these enlarged glands are very varied, and for full details the reader is referred to the elaborate section in the Traité of Barthez and Sanné (tome 3). It is sufficient here to say that there are instances on record of compression of the superior cava, of the pulmonary artery, and of the azygos vein. The trachea and bronchi, though often flattened, are rarely seriously compressed. The pneumogastric nerve may be involved, particularly the recurrent laryngeal branch. More important, really, are the perforations of the enlarged and softened glands into the bronchi or trachea, or a sort of secondary cyst may be formed between the lung and the softened bronchial gland. Perforations of the vessels are much less common, but the pulmonary artery has been opened. Perforation of the œsophagus has been described in several cases. One of the most serious effects is infection of the lung or pleura by the caseous glands situated deep along the bronchi. The infection may, as is often clearly seen, be by direct contact, and it may be difficult to determine in some sections where the caseous bronchial gland terminates and the pulmonary tissue begins. In other instances it takes place along the root of the lung, and is subpleural. Among rarer sequences may be mentioned diverticula of the œsophagus following adhesion of an enlarged gland and its subsequent retraction, and, in the case of the anterior mediastinal and aortic groups, the frequent association of tuberculous adenopathy and pericarditis, either by contact or by rupture of a softened gland into the pericardium.

Symptoms.—In the great majority of instances there are no indications whatever, and even in enormous enlargement pressure-signs may not have been present. Authors differ extremely in their views on this point. Many hold, and I think correctly, that the manifestations, as a rule, are very slight. Compression of the veins leading to dropsy, dilatations of the veins causing cyanosis, and hæmorrhages are referred to by Barthez and Sanné. Alterations in the character of the heart-sounds and attacks of paroxysmal dyspnœa are described by the same writers. The latter come on suddenly, often at regular hours, frequently in the afternoon, and there is extreme oppression with rapid breathing, cyanosis, and cold sweats, almost like an attack of severe croup. These paroxysms may succeed each other, and they have been ascribed not so much to pressure at the bifurcation of the trachea as to compression of the vagi, causing in this way laryngeal spasm. More definite, undoubtedly, is the compression of one or other bronchus, causing feeble breathing on the side most

affected, with sibilant and fine râles. Usually, however, when the glands are very much enlarged the lung is also involved, and it may be difficult to say how far the alterations are due to the changes in it. Still less reliable is the information obtained on percussion, for the dulness in the upper part of the sternum and in the interscapular spaces is, when present, by no means a positive sign. The thymus may cause sternal flatness on percussion; and behind, unless the glands are enormously enlarged and the child very thin, it is difficult to determine any special modification of the resonance in the interscapular space between the first and third dorsal vertebræ.

(*d*) Mesenteric Glands (Tabes Mesenterica).—The glands involved are those of the mesentery and the gastro-hepatic omentum and the chain of retroperitoneal glands along the aorta; more rarely those of the pelvis. Tuberculous disease of these glands is extremely common; thus of 127 cases of fatal tuberculosis in children, noted by Woodhead, these structures were involved in 100, while Ashby states that of 103 consecutive post-mortems on children dying of tuberculosis, in 62 there was tuberculous ulceration of the intestines; in 71, cheesy mesenteric glands; in 55, both ulcers and cheesy glands; in 7, tuberculous ulcers without involvement of the glands; and in 16, cheesy glands without ulcers. Of 144 children in which the mesenteric glands were tuberculous, only 44 showed neither ulcerations nor tubercles in the intestines (Barthez and Sanné).

In a great many instances the condition is found accidentally in children who have died of other diseases. Unquestionably, as is indicated by these figures, the infection in many of these cases is primary in the glands. Lesion of the intestines is not necessary. Some experiments have shown that the bacilli may gain entrance through a healthy mucosa. A special interest relates to the possibility of infection by the bacilli in milk, more particularly as it is well known that in animals experimentally fed with infected milk primary tuberculosis of the intestines, with extensive disease of the mesenteric glands, has been produced. The question will be referred to again on the subject of primary tuberculosis of the intestines. The cases fall into four groups:

(1) Very slight tuberculous affection of a few glands (which may be the only ones), met with accidentally in children who have died of various disorders.

(2) In the chronic generalized tuberculosis, in both the acute and chronic pulmonary tuberculosis, and in the more chronic forms of tuberculosis of any of the organs in children, the mesenteric glands may be found enlarged and caseous. There are instances, too, in which the affection of the mesenteric and retroperitoneal glands with those of the thorax constitutes the chief lesion.

In both these groups the disease of the glands does not necessarily cause any symptoms pointing to abdominal disorder.

(3) In a third group there are signs of chronic intestinal catarrh or ulceration and very marked disturbance in the general nutrition. These cases are seen chiefly in children between the ages of eighteen months and five years. The abdomen is distended, tympanitic, usually a little painful on deep pressure, but no nodules are felt. The diarrhœa is the most troublesome symptom; the stools are frequent, brownish or yellow-brown in color, containing mucus, not often blood. The diarrhœa is variable, and may sometimes persist for several weeks. There is usually slight fever, but the general wasting and debility are the most characteristic features. The name *tabes mesenterica* is often applied to this condition. The course is chronic and may extend over a

year or two, leading to the most extreme emaciation. It is sometimes very difficult to determine whether actual tuberculous disease of the bowel is present or not, as a chronic intestinal catarrh may lead to just such a condition of extreme debility and wasting. In the diagnosis of these cases much stress can be laid upon the presence or absence of tubercles in other parts.

(4) And, lastly, there are cases in which with ulceration of the intestines the mesenteric glands are greatly enlarged, and in addition the peritoneum is involved. Here the diarrhœa, the slight fever, the malnutrition, and progressive wasting are as in the previous group; additional symptoms are associated with disease of the peritoneum, in which nodular masses may be felt, and there may be considerable ascites. These cases will be referred to more particularly under Peritoneal Tuberculosis.

(2) Tuberculosis of the Intestines and of the Abdominal Organs.

(*a*) Tuberculosis of the bowels.—The small intestine is most frequently involved; thus, of 141 children presenting tuberculous ulcerations in the gastro-intestinal canal (Barthez and Sanné), in 134 the small intestine was involved; in 60, the large intestine; in 71, the small intestine alone. It is remarkable, considering the comparative rarity in the adult of tuberculous disease of the stomach, that in this series it should have been met with in 21 cases. That tuberculosis may originate in the alimentary canal is shown experimentally by the feeding of guinea-pigs with cultures of the bacillus and the feeding of calves and pigs with the milk of tuberculous animals. There are now many series of cases demonstrating the facility with which animals may be infected through this latter source. That the intestinal lesion may be primary in children is acknowledged. The comparatively large number of children with caseous foci in the mesenteric glands is very suggestive. On the other hand, instances of primary intestinal tuberculosis are not very common.

In a great majority of the cases the tuberculous lesions are part of a general infection, and are undoubtedly secondary. The ulcers are situated chiefly in the ileum, involving the solitary and agminated follicles of Peyer. The tubercles may be seen as small granulations in the submucosa; sometimes the whole ileum may present a remarkable appearance from the grayish-yellow nodular tubercles, the size of split peas, occupying the submucosa and the mucous membranes. The caseation and necrosis lead to ulceration, which may be very extensive, involving at first Peyer's patches, but ultimately extending beyond their limits. The tuberculous ulcer has the following characters: It is "transverse to the long axis, rarely ovoid, often irregular in outline; the edges and base are infiltrated, often caseous; the submucosa and muscularis are also involved in the tuberculous process; and, lastly, colonies of young tubercles or well-marked lymphangitis may be seen on the serosa."

Primary tuberculosis of the bowel is, as stated, rare; but in children with extensive ulceration in the ileum and very slight lesions of other parts the disease may be regarded as primary; thus in a child aged nine who was admitted to my wards with dropsy and emaciation after an illness of six months' duration, there were only a few small foci in the lungs, while the intestines showed most extensive disease. About 50 cm. below the duodenum there was a large circling ulcer, the edges of which were undermined, the bases irregular and worm-eaten, and containing necrotic, grayish material. The peritoneum over it was thick and opaque. Throughout the whole of the ileum there was a series of these girdling ulcers at varying intervals. The cæcum presented a very

large, deep ulcer, while the mesenteric attachment about the ileum formed a large tumor-mass from the extent of the involvement of the glands. The peritoneum presented scattered tubercles and the mesenteric glands were enormously enlarged.

In a few instances tuberculous disease of the bowels extends from a chronic tuberculous peritonitis in which the coils of the intestine become matted together, caseous and suppurating foci develop between the folds, and perforation may occur in several places.

Symptoms.—The symptoms of intestinal tuberculosis are very varied. The most common indication is a persistent diarrhœa. It is not always, however, proportionate to the extent of the ulceration, and large ulcers in the ileum may exist with constipation. When the ulceration is extensive in the large intestine the diarrhœa is usually profuse and obstinate. The mode of onset is variable. In a few instances of general tuberculosis there is diarrhœa from the start. In a large number of cases the existence of intestinal complication is not suspected until the signs of disease in other organs are well marked; and in perhaps a majority of the secondary cases the diarrhœa is rather an event of the latter part of the illness. Of other symptoms, hæmorrhage may occur, or peritonitis from extension—a condition not very uncommon, and often associated with disease of the mesenteric glands. The abdomen in these cases is usually enlarged and painful, and the nodular masses may be felt. In a few instances there are gastric symptoms, which do not necessarily indicate ulceration in the stomach, but there may be loss of appetite and occasional vomiting, and there are instances on record of profuse hæmatemesis or melæna from erosion of an artery.

The outlook is unfavorable, and death may be caused by the severity of the intestinal symptoms, or more rarely by the accidents, such as perforation or hæmorrhage.

Recognition is rarely difficult, except in the primary cases, which are regarded at first as simple entero-colitis. Usually, however, when well established, the diagnosis is easy, particularly when other organs become involved. In suspected cases the stools should be carefully examined for tubercle bacilli.

(*b*) Tuberculosis of Liver.—In all cases of acute miliary tuberculosis granulations are found in this organ; sometimes they are extremely minute and are only detected microscopically. The liver is usually somewhat enlarged, pale, and fatty. In more chronic cases, particularly the diffuse generalized tuberculosis of young children, the tubercles may attain considerable size and develop about the finer bile-ducts. They undergo rapid softening, and give a very remarkable appearance to the liver, which is in extreme cases almost honeycombed with tuberculous abscesses, varying in size from a pea to a marble; the pus is usually bile-stained.

Occasionally large, coarse, caseous masses are found forming irregular tumors, most frequently in association with perihepatitis or tuberculous peritonitis. The so-called tuberculous cirrhosis of the liver does not, I believe, occur in children, though there may be in chronic cases of tuberculosis a marked increase in the connective tissue of the organ.

(*c*) Tuberculous Peritonitis.—Tuberculosis is one of the most common causes of peritonitis in children. It is more common about the eighth and tenth years, and attacks boys more frequently than girls; thus of 86 cases analyzed by Barthez and Sanné, there were from

1	to	2½	yrs.	11 cases.
3	to	5½	"	26 "
6	to	10½	"	40 "
11	to	15	"	9 "

The ratio of frequency in children may be gathered from the large statistics of Aldibert, who found in 326 cases of tuberculous peritonitis, 52 in children. As in the adult, the disease may be primary, but in a majority of the cases it is secondary to tuberculosis of the intestines, mesenteric glands, or of the genitalia.

Morbid Anatomy.—Tubercles in the peritoneum are not infrequently met with in the bodies of children dead of tuberculosis. Ashby noted them 38 times in 105 post-mortems on tuberculous children. They occur either as (1) the gray granulations with or without exudation, serous or sero-fibrinous. Sometimes the entire peritoneum is found studded with (2) firm, hard, fibrinous tubercles surrounded by a pigmented and firm connective tissue. In both of these varieties the process may be latent, and the condition is met with accidentally post-mortem. More frequently (3) when symptoms have been present, the tubercles are in the form of caseous nodules, yellow-gray in color, often forming flattened tuberculous plaques. The exudate is purulent or sero-purulent, the coils of intestines are much matted together, and between them there may be large caseous masses. It may be impossible to separate the coils, and in advanced cases extensive ulceration occurs, with multiple perforation of the intestine. There are three anatomical points of special interest in these cases: First, the effusion may be sacculated and form a definite tumor; sometimes the process is confined to the cavity of the lesser peritoneum; in other cases it is in the pelvis, less frequently in the middle portion. The cysts may be multi- or mono-locular.

Second, there are cases in which occlusion of the intestine has resulted, sometimes from compression of the coils by the large caseous masses; more frequently by the bands of connective tissue in the healing of the process. Aldibert has found five instances of this sort in children.

Lastly—and much more frequently in children than in adults—there is peri-umbilical suppuration. The intensity of the inflammation is in the central portion of the abdominal cavity, adhesions take place, and a definite cyst is formed, usually purulent, which projects at the umbilicus, and often opens spontaneously, leaving a fistula, sometimes stercoral, which persists for months but may ultimately heal.

Symptoms.—The symptoms of tuberculous peritonitis are extremely varied, and it is very difficult to give a clear and definite picture of the disease. For convenience three clinical types may be considered:

(1) *The Ascitic Form.*—The symptoms may come on acutely with a diffuse eruption of miliary tubercles. So abrupt is the onset that cases have been mistaken for acute enteritis, or even for acute obstruction or hernia. More frequently the onset is subacute, and ascites gradually develops. Fever of some degree, indigestion, and diarrhœa are present, and there may be abdominal pain; but in many instances the process is latent, and the enlarging abdomen is the symptom for which the physician is consulted. The effusion, indeed, may proceed to considerable degree without fever, and with no symptoms other than those of gradually-failing health and progressive emaciation. Intestinal disorder occurs in some instances, diarrhœa, colicky pains, or often attacks of diarrhœa alternating with constipation. The local symptoms are by no means characteristic. The abdomen is distended, the skin thin, the superficial veins

enlarged. Percussion gives dulness in the flanks, which is movable, resonance in the umbilical region, and there is a well-marked fluctuation wave. Palpation may be entirely negative; no nodular masses are felt. The liver and spleen are not often enlarged. It may be extremely difficult, or quite impossible, unless there are tuberculous lesions in other regions, to speak definitely of the nature of the gradually-developing ascites. The clinical picture is very similar, indeed, to that of the cases of ascites from cirrhosis, and an identical condition is met with in the rare cases of simple chronic peritonitis in children. The ascites may demand tapping, but the fluid reaccumulates rapidly. The exudate may be encysted, forming a prominent tumor in the epigastric or umbilical regions (in which case the effusion is probably within the lesser peritoneum), or it may be situated in the pelvis or in the flank, and simulate very closely cystic ovarian disease. This form is not very uncommon in children, and very good results have followed operation; of nine instances in the literature, all recovered. This ascitic form, developing slowly, and ultimately presenting the picture of a chronic ascites or an encapsulated exudate, is by far the most favorable variety, and cases may recover spontaneously or after operation.

(2) *The ulcerative form* is much more serious. The peritoneum here contains larger caseous masses which break down, and there is a diffuse purulent peritonitis. The coils of intestines are matted together, nodular tuberculous masses develop on the parietal and visceral layers, the glands are greatly enlarged, and in protracted cases extensive ulcerations occur. The onset in this form is usually gradual, but the abdominal symptoms are pronounced. The child complains of colicky pains, diarrhœa, and chronic indigestion. The abdomen is enlarged and painful. The condition on examination may be entirely different from that of the ascitic form. The outline is often symmetrical, not flattened in the flanks; nodular projections may sometimes be seen beneath the skin. Unless there is a very extensive purulent effusion there is no movable dulness. There is a flat tympany or there are alternating areas of resonance and dulness. On palpation there is a boggy, doughy feel, and nodular masses may be felt in different regions. The liver and spleen may both be enlarged. In this suppurative form the effusion may be general, or it may be encysted either in the upper abdominal region or in the pelvis. One form of this encysted suppurative variety requires special consideration—namely:

Periumbilical Tuberculous Abscess.—This is seen most frequently in children, and is in reality a localized suppurative peritonitis, which points at the navel and frequently opens and discharges. The condition is almost constantly tuberculous in the child. There may be a fistula discharging pus for weeks or months, and recovery may ultimately take place. In other instances the fistula communicates with the bowel. In the case of a colored child, aged five, operated upon by my colleague, Dr. Halsted, there was distention of the abdomen, marked protrusion of the umbilicus, and here a spontaneous opening discharging yellowish material for months. Then the opening healed and the condition of the child improved. At the time of the operation there was a large, prominent, cone-shaped, umbilical tumor. The child died some time after the operation; creamy pus was found between the intestinal coils, and there were many tuberculous ulcers in the intestines. There was an extensive caseous salpingitis.

There are instances also of perihepatic tuberculous abscesses.

(3) *Chronic Adhesive or Dry Tuberculous Peritonitis.*—In a very considerable number of all cases of tuberculous peritonitis there is little or no serous or purulent exudate, but the tubercles are surrounded with a fibrinous lymph

and they tend rapidly to cicatrize. The growing tubercles may not have caused any symptoms, and the condition is found accidentally post-mortem, and in adults has often been met with in exploratory laparotomies for various conditions. In long-standing cases the tubercles are hard, firm, often surrounded by deeply pigmented fibroid adhesions. In some of these instances the tuberculosis of the peritoneum is localized; thus it has been found in a hernial sac alone, or in the region of the cæcum and appendix, or on the epiploön. There are instances in which this membrane has been gradually curled and rolled until it forms a ridge-like tumor lying across the upper portion of the abdomen. This chronic adhesive form is not so frequent in children as in adults. The symptoms are very indefinite. The abdomen is usually distended and tympanitic, everywhere resonant, sometimes distinctly painful on pressure. In protracted cases the omentum may be felt as a firm ridge in the upper portion of the abdomen. The general symptoms are very variable. There may be wasting and cachexia, sometimes with marked fever, though these chronic adhesive forms are not infrequently afebrile throughout, or the temperature, indeed, may be subnormal. With the exception of the colicky pains there may be no symptoms directly from the peritoneum, but the cases are very often complicated with tubercles in other parts, and the mesenteric glands or the lungs may be extensively diseased. These are cases in which spontaneous recovery is not infrequent.

Diagnosis.—A gradually developing ascites in a young child with moderate fever is in itself very suggestive of peritoneal tuberculosis. Doubtless very many of the cases of simple ascites with recovery belong to this disease.

The condition is to be distinguished from ascites due to disease of the liver and from chronic simple peritonitis. Cirrhosis of the liver, syphilitic or simple, is a rare disease in children. The local symptoms may give us no clue, but after withdrawal of the fluid the liver in a cirrhotic case may be felt to be unusually hard, and perhaps small, and possibly, when due to syphilis, irregular. The general symptoms are more important. In cirrhosis there is more frequently a slight jaundice. The fever and gastro-intestinal symptoms are not so marked. An encysted exudate is always in favor of tuberculosis. A simple chronic peritonitis, though rare, occurs in children, and, even after the exploratory laparotomy, the diagnosis may not be clear, inasmuch as there may be small nodular fibroid bodies scattered over the membranes. It is very important in these cases to have a careful microscopical examination made, in order to determine the presence of bacilli, or, if the nodules are very firm and fibroid, the experimental test should be made. It is quite possible that some instances of reported recovery in peritoneal tuberculosis after laparotomy may have been instances of this chronic simple peritonitis with fibroid nodules. The ulcerative form with suppuration and the development of nodular masses in the peritoneum with fever and a marked cachexia, rarely offers the slightest difficulty in diagnosis. It is to be remembered, of course, that the suppurative forms also may be encysted, and the periumbilical abscess with umbilical fistula, simple or stercoral, is almost constantly tuberculous.

Prognosis.—The prognosis is often good, particularly in the ascitic and chronic adhesive varieties. Many instances, no doubt, in which the ascites has gradually disappeared have been tuberculous, and even in the ulcerative variety, when the abscess has discharged at the navel, recovery has followed. The operation of incision and drainage has certainly favored recovery in a considerable number of cases.

Treatment.—The general treatment of tuberculosis will be discussed at the end of the section; here reference will be made more particularly to incis-

ion and drainage in tuberculous peritonitis. The results which have been obtained are exceedingly satisfactory, even if we suppose, as is probable, that many cases relapse and are not fully healed at the time of reporting. The figures given in the monograph of Aldibert are extremely interesting: in the ascitic form, of 32 instances in which laparotomy was performed, there were 3 deaths and 29 recoveries, 4 of which had persisted for more than one year. This demonstrates the impunity with which the abdominal cavity may be opened, and the large percentage, at any rate, of those which are benefited immediately by the operation. In the chronic adhesive form an operation is really not indicated, as in the majority of the instances the tuberculosis is in process of healing, but there are cases in which pain, associated with the adhesions, has been relieved by an exploratory incision. In the ulcerative variety, when generalized, the results have not been so satisfactory, but many instances with an encysted purulent fluid have been opened and drained successfully. The drainage favors the process of cicatrization in the tubercle, lessens the tendency to effusion, and exerts a favorable influence on the whole process. Of the 52 cases in children in which laparotomy was performed, there were 45 recoveries and 7 deaths. Of these 45, 9 had persisted for more than a year, and 2 for more than two years (Aldibert).

(3) Tuberculosis of the Lungs.

In speaking of acute miliary tuberculosis and of chronic diffuse tuberculosis we have considered affections in which the lungs are almost constantly involved —in the one case the seat of miliary granules; in the other of larger, coarse, grayish-yellow tubercles. We shall speak in this section more particularly of those forms in which the lungs are so involved, that the clinical features are those of an acute or of a chronic pulmonary disease. Two groups of cases may be recognized: the acute tuberculous broncho-pneumonia, and the chronic ulcerative form, the first corresponding to the acute galloping phthisis, and the other to the chronic phthisis, or, as we call it now, chronic pulmonary tuberculosis.

(*a*) Acute Tuberculous Broncho-pneumonia.—In infants and children we very rarely see pulmonary tuberculosis set in with the clinical picture of an acute lobar pneumonia. Personally, I never remember to have met with an instance, such as is not very rare in adults, in which the tuberculosis came on abruptly, and at first ran the course of an ordinary lobar pneumonia, with pain in the side, high fever, and rapid consolidation of an entire lobe. Such cases are, however, on record, and it is only the absence of the crisis, the persistence of the local signs, the gradual softening, and the development of hectic and progressive debility which lead to a revision of the diagnosis. It is to be remembered that while clinically the physical signs may be those of a lobar affection, anatomically it is clearly seen that many groups of lobules are involved, separated by strands of air-containing or collapsed lung-tissue. These *pseudo-lobar* cases are almost impossible to differentiate during life.

Tuberculous broncho-pneumonia is common in children from the sixth month to the fifth year. A large proportion of the cases occur after the second year.

The disease is most common in children in institutions, in those debilitated by previous illnesses, and more particularly in convalescents from one of the infectious diseases—measles, whooping-cough, scarlet fever, or diphtheria. It is most frequent perhaps after measles and whooping-cough. Its sequence in the latter disease has been common knowledge in the profession since the days

of Willis, whose axiom, "Tussis convulsiva vestibulum tabis," has been quoted through two centuries. Children the subject of chronic naso-pharyngeal catarrh and tonsillitis, and mouth-breathers seem more prone to the affection. But it is to be remembered that it may develop in perfectly healthy, well-nourished children.

And lastly, like miliary tuberculosis, it may be a terminal process in cases in which local tuberculous disease exists in other parts—the skin, bones, lymph-glands, or the urogenital tract.

Morbid Anatomy.—The condition varies considerably with the intensity and duration of the process. The lungs may be voluminous and crepitant, with firm and nodular masses scattered throughout the lobes. On section these are seen to be peribronchial nodules ranging in size from a pea to a walnut. Some of the more recent are reddish in color; the older are grayish-yellow, with, perhaps, central softening. Many of these peribronchial nodules are seen to be composed of aggregations of tubercles undergoing caseation. In the very acute cases the process is more extensive in the upper lobes or central portion of the lungs, certain parts of which may be almost solid and scarcely contain any air. The consolidation may indeed look uniform, but on section it is noted that the process is not actually diffuse, as in a lobar pneumonia, but the general consolidation has arisen from the involvement of a very large number of the lobules, groups of which are separated by strands of reddish collapsed tissue. The consolidated areas have undergone caseation, and may in places have softened, forming cavities. The older the process the more extensive usually are the areas of caseation. Though primarily tuberculous, many of these cases show a mixed infection, and there may be areas of simple broncho-pneumonia due to streptococci, staphylococci, or pneumococci. The pleura may show many nodules or a fresh, fibrinous exudate, sometimes a sero-fibrinous or even purulent exudate. The bronchial and tracheal glands are enlarged, tumefied, and studded with tubercles or uniformly caseous, not infrequently having softened to form definite abscess. The glands at the hilus may be greatly enlarged and extend deeply between the lobes, and in some instances there would appear even to be an invasion of the lung-tissue from these deeply-placed large caseous glands. The other organs may present a few scattered tubercles or there may be a generalized miliary tuberculosis.

As in other forms of broncho-pneumonia, the essential lesion is a bronchitis and peribronchitis excited by the tubercle bacilli, with inflammation of the contiguous air-cells, which become filled with epithelial products, the so-called catarrhal alveolitis. The accompanying phenomena of atelectasis and emphysema occur just as in simple broncho-pneumonia, and the distinguishing features are the caseation and necrosis with the presence of the bacilli.

Much discussion has taken place upon the relation of broncho-pneumonia to tuberculosis, and some French observers have maintained that in many instances the form following measles and diphtheria, and which anatomically looks simple in character, is in reality tuberculous and due to the bacilli. It may be difficult sometimes to determine whether a given patch of broncho-pneumonia is tuberculous or not, but as a rule, macroscopically, there will be seen small tubercles or areas of caseation, while in stained sections the bacilli are readily demonstrable. The simple broncho-pneumonia in some cases precedes the tuberculous, particularly after measles, scarlet fever, diphtheria, and whooping-cough. In institutions it is by no means uncommon to meet with cases in which broncho-pneumonia has gradually subsided, and then symptoms have developed pointing to fresh invasion, and ultimately death follows with the lesions of an acute, recent, tuberculous broncho-pneumonia. Sometimes the

infection is less intense, and a subacute or chronic pulmonary tuberculosis is established. In cases of tuberculosis consecutive to broncho-pneumonia we find the lesions of two sorts: simple, inflammatory, non-tuberculous, such as peribronchial suppuration, dilatation of the bronchi, lesions of the alveolar epithelium, and peribronchial and peri-alveolar sclerosis; then, in addition, there are the true tuberculous processes, peribronchial nodules, tuberculous infiltration, and caseous areas (Mosny).

In other instances the tuberculosis precedes the broncho-pneumonia. This is met with particularly in children the subject of latent tuberculosis, in whom, following one of the infectious diseases, a simple broncho-pneumonia develops. According to Mosny, the lesions may be seen as an alveolitis surrounding the tuberculous peribronchial nodules, or foci of simple and tuberculous broncho-pneumonia occur scattered throughout the apices of the lung. It is a broncho-pneumonia dependent upon pneumococci or streptococci invading a lung already the seat of local tuberculosis.

Symptoms.—Clinically, tuberculous broncho-pneumonia scarcely differs in any feature from the simple form. The onset may be acute in a previously healthy child, but more frequently the disease sets in during convalescence from one of the infectious diseases. In the tuberculous form the fever is sometimes not so high and not so persistent, showing more variations throughout the day. Cough and dyspnœa are prominent symptoms. The physical signs are those of broncho-pneumonia. The localization of the lesion is more commonly at the apices of the lung, where there may be signs of consolidation with fine crepitant and subcrepitant râles. There are no physical signs of any moment in differentiating a simple from a tuberculous broncho-pneumonia, and indeed even the localization of the disease at the apex, upon which so much stress is laid, is not of very much value, since we frequently find in young children a tuberculous process beginning at the base or in the central portions of the lung. In the course of the disease, however, indications of great value develop; thus toward the end of the second week there are more marked oscillations in temperature, often with profuse sweats. The child emaciates rapidly, and there may sometimes develop signs indicating softening. In the acute cases the duration is from three to five weeks. Throughout the course of the disease there may be no single indication of much value in definitely determining the nature, and we often have to depend more on the general features of the case. Careful inquiries should be made as to heredity; also the personal history immediately preceding the onset. Sometimes important information may be gathered by a systematic examination of the child. There may be a tuberculous adenitis, local bone disease, or a tuberculous testis. Simple broncho-pneumonia tends as a rule to recovery; in exceptional cases, however, it becomes subacute, and ultimately chronic. In the more subacute and chronic cases tuberculous broncho-pneumonia may present large areas of caseation, which give the physical signs of consolidation, perhaps of an entire lobe. In such instances softening and the signs of cavity not infrequently develop, and give very definite indications of the nature of the process. As the little patients rarely expectorate, examination for bacilli can seldom be made. Sometimes, if vomiting occurs, portions of mucus may be picked out, and important evidence in this way obtained.

(*b*) Chronic Pulmonary Tuberculosis.—In infants and very young children we find the lungs either involved in a generalized tuberculosis or the seat of an acute tuberculous broncho-pneumonia. After the sixth or eighth

year cases are not very uncommon in which the picture resembles that of chronic tuberculosis pulmonum of the adult.

Morbid Anatomy.—The lesions are similar to those met with in the tuberculosis of adults—miliary tubercles, peribronchial nodules, caseous blocks, areas of softening and of fibroid induration, and cavities of various sizes. We do not see so frequently the invasion of the lung from the apex downward. The chief seat of disease may be in the central portion of the lung, or even at the base. As already mentioned in speaking of tuberculosis of the lymph-glands, the groups along the trachea and about the bronchi may be greatly enlarged and caseous, forming on section a very striking feature in the chronic pulmonary tuberculosis of children. Indeed, in some instances the process seems to spread directly from the deeply-placed glands in the hilus of the lung, which may be enormously enlarged, uniformly caseous, and the organ may be directly invaded from them. Large areas of caseous pneumonia are not uncommon, and often present foci of softening. Small cavities are by no means infrequent in chronic pulmonary tuberculosis of children, but very large excavations are rare; thus in the 265 cases noted by Barthez and Sanné there were 77 cases with excavation, chiefly, too, in the upper lobes. In the analysis by Leroux of the cases of the late Professor Parrot, in 219 children under two years of age there were 57 instances in which cavities existed. In 5 of these the children were under three months. In long-standing cases hard, firm, fibrous tubercles are found, and sometimes cretaceous nodules. The primary lesion in a great majority of instances is a tuberculous broncho-pneumonia, taking its origin in the smaller bronchioles, leading to peribronchial nodules and subsequent peribronchial alveolitis.

Symptoms.—The general symptomatology of chronic pulmonary tuberculosis in the child is similar in essential details to that of the adult, but presents, however, as might be expected, certain peculiarities. The onset is generally more abrupt, and the first symptoms may be those of a broncho-pneumonia at the apex. The child may have been in failing health or come of a markedly tuberculous stock, or there may have been local glandular or bone disease. Occasionally failing health, with repeated attacks of chills and fever, may arouse the suspicion of malaria, but this mode of onset is not so frequent as in adults. Some cases follow a protracted naso-pharyngeal catarrh with recurring bronchitis. Progressive failure in health and strength, cough and fever, are the first symptoms to attract attention. There is loss of appetite, but rarely the extreme anorexia which we find in some cases of pulmonary tuberculosis in older subjects. Cough is rarely absent among the initial symptoms, and, with variations, persists. It is short and dry at first, subsequently looser. It may be distributed equally throughout the day or is most troublesome at night, and paroxysms of coughing may return at fixed hours, so that the case may be mistaken at first for whooping-cough; but there is never the noisy crowing inspiration. Expectoration is absent in very young children. Children above the age of ten can often be taught to expectorate. The sputum is mucoid at first, with grayish-yellow streaks; sometimes it is more sero-mucoid, and in the later stages more definitely purulent. Hæmoptysis may be said to be infrequent in children under ten. Certainly it is very rare at the onset. It is usually small in amount. The terminal hæmoptysis, common in the adult, but rare in children, results from the rupture of an aneurism in a small cavity or erosion of a branch of the pulmonary artery. The fever of onset and during the early periods is remittent, the daily excursions slight—a range between 102° and 104° is common. Subsequently, when the disease is more extensive and softening has taken place with the formation of cavities, the temperature is more

hectic in character, and the morning observation may be normal or subnormal, while in the evening the thermometer may register 103.5° or 104°, or even higher. Chills are not very common. Drenching sweats are frequent, particularly toward the close. Dyspnœa may be present at the onset and during the early stages, and may be due in part to the fever, sometimes to the presence of a diffuse bronchitis. Marked increase in the respirations, with cyanosis, indicates very rapid progress in the disease. In protracted cases, just as in the adult, there may be very extensive destruction of the lung without the slightest dyspnœa. The child may complain of pains in the chest, usually associated with pleurisy. In a majority of instances the disease is painless throughout its course. Qvisling states that an early sign is tenderness on percussion of the affected side, or on pressure in the intercostal spaces, particularly in the first space at the apex.

Progressive weakness and wasting are very pronounced symptoms, and there is usually progressive pallor. Frequently the abdominal viscera become involved, and there is diarrhœa due to tuberculous ulceration, and the liver and spleen may become enlarged. The urine does not often show changes, but as the disease progresses albumin is common and a secondary nephritis may develop. A child may come under observation with general anasarca, due partly to the anæmia, partly to the renal condition, and the pulmonary tuberculosis may be entirely overlooked.

Physical Signs.—*Inspection* frequently shows in advanced cases an extremely thin chest, with marked intercostal spaces. Deformities due to mouth-breathing or to rickets are not uncommon. On the affected side the respiratory movement may be decidedly less marked, or the clavicle may stand out prominently; or there may be subclavicular depression at the affected apex—a sign usually of a chronic process. In very long-standing cases with much fibroid change there may be flattening of the affected side, with depression of the shoulder.

By *palpation* one appreciates any differences in expansion on the two sides, and the differences in the tactile fremitus, and it may be of value in eliciting painful points.

Percussion.—In the early condition, when the tubercles are scattered or the areas of broncho-pneumonia are limited, there may be no change in the percussion note. Indeed, the emphysema about the affected areas may cause slight hyper-resonance over the part affected. Extensive involvement at one apex usually gives loss of resonance beneath the clavicle, which may amount to dulness and is accompanied with marked increase in the resistance. Absolute flatness is rarely met with. Skoda's resonance, the flat tympany, is not frequent. The cracked-pot sound has very little value in children, as it may sometimes be elicited in a thin-walled healthy subject.

Auscultation may give only the signs of bronchial catarrh, piping râles and moist sounds, but when there is definite dulness there is usually change in the character of the respiratory sounds, which have lost their vesicular character and are harsh, broncho-vesicular, or definitely bronchial. Sometimes with defective resonance there is enfeeblement of the respiratory murmur, with prolongation of expiration. The auscultatory phenomena are often very deceptive. Diffuse bronchitis may lead us to suppose that there is much greater involvement of the lung than in reality exists. In very young infants signs of cavity are rarely present, but in older children in advanced cases, with hectic and emaciation, the metallic splashing or amphoric quality of the râles, with the loud cavernous breath-sounds, leaves no doubt as to the existence of a vomica. In children, more frequently than in adults, we are deceived by the

so-called pseudo-cavernous signs. Over an area of slightly defective resonance or of positive dulness inspiration and expiration are cavernous, the râles large and resonant, and the whispered voice may be conveyed intensely to the ear. In acute cases with high fever one is not so apt to be deceived; these signs are also met with in broncho-pneumonia and in pleurisies.

Course.—The course of chronic pulmonary tuberculosis is more rapid in children than in adults, and a majority of cases die in from six to twelve months. The disease is marked, now by intervals of improvement, in which the fever lessens and the severity of the symptoms subsides, now by aggravation of the local and constitutional condition, sometimes with attacks in which the fever and dyspnœa increase, and the child may become quite cyanotic. Some of these intercurrent attacks simulate closely acute tuberculosis, but often pass away at the end of a week or ten days. In the chronic cases they probably indicate the invasion of other portions of the lung.

Occasionally, in a case of chronic pulmonary tuberculosis extensive fibroid substitution takes place, with gradual retraction of the affected side, depression of the shoulder, and all the signs of so-called fibroid phthisis. Usually in such instances there is dulness at the base and side with modified resonance, and cavernous signs at the apex. When involving the left lung, the heart is drawn over, and there may be a very extensive cardiac pulsation from the second to the fifth interspaces. A child may gradually regain a fair measure of health and for years live a tolerably comfortable life, troubled only by one or two spells of coughing through the day. There may be dyspnœa on exertion, and gradually the terminal phalanges become clubbed. Hæmoptysis is rare, but occasionally terminates the case.

Diagnosis.—Progressive emaciation with hectic and cough in a child should always arouse the suspicion of chronic pulmonary tuberculosis. In the early stages the condition is usually that of tuberculous broncho-pneumonia. Careful and repeated physical examination may be necessary to establish the diagnosis, and one should take into consideration carefully the condition of the other organs. The position of the physical signs at the apex or central portions of the lung, the increased fremitus, the moist sounds, are all suggestive, and frequently one may trace the progressive character of the lesion. The disease most frequently confounded is empyema, but here the movable dulness, the bulging of the intercostal spaces, and the absence of fremitus are valuable points.

Auscultation is an extremely fallacious guide, and in several instances the persistence of a loud, almost cavernous, respiratory murmur at the base has led the practitioner astray. When in doubt the exploratory needle should be freely used for the purpose of diagnosis. The differentiation of chronic simple broncho-pneumonia sometimes gives a great deal of trouble, and the time element alone may determine whether we have to do with a tuberculous process or not. These are the very instances in which any fragments of sputum should be carefully sought for and examined. In a paroxysm of coughing the child may bring up a mouthful of food, and with it the expectoration, which should be carefully picked out and examined for tubercle bacilli.

Prognosis.—The prognosis in a large majority of the cases is bad, particularly when hectic is established and there is disorganization of one lung. On the other hand, when cases are seen early and placed under suitable conditions recovery may take place. The large number of individuals whose lungs and bronchial glands present traces of old tuberculous processes shows how considerable a proportion of all those who are infected must survive. We do not see many cases of chronic pulmonary tuberculosis in children between the ages

of six and fifteen, for the reason, no doubt, that the tuberculous broncho-pneumonia is so often an acute process, carrying off the victim before it has assumed the characters of a chronic affection.

(4) Tuberculosis of the Pleura.

This is usually secondary to existing disease in the lung or in the bronchial glands. A certain number of acute serofibrinous pleurisies in children may be, as in the adult, due to tuberculosis; but the cases, as a rule, run a favorable course, and unless the child has definite manifestations of tuberculosis in other parts the assumption in any given case is of course purely gratuitous. Purulent pleurisies in children are most commonly associated with lobar or broncho-pneumonia, but in a certain proportion of the cases the process is tuberculous. The disease is usually latent, and failing health, pallor, and shortness of breath are the symptoms for which relief is sought. The general symptomatology and diagnosis of tuberculous pleurisy are practically those of the simple forms which are elsewhere considered.

(5) Tuberculous Pericarditis.

This is by no means rare in children, and cases have been reported in infants under a year. In 65 cases collected from the literature by Brackman, 19 were in children. The disease is associated in almost all instances with tuberculosis of the mediastinal or bronchial glands. An enlarged and softened gland may perforate the pericardium and produce an acute sero-fibrinous or suppurative inflammation; and no doubt a considerable number of all the cases of so-called idiopathic suppurative pericarditis have been due to this cause. The tuberculous process may slowly invade the pericardium from the mediastinal glands, and produce a chronic adhesive pericarditis, leading to great thickening of the membranes and gradual hypertrophy of the heart. The patient may die with all the symptoms of cardiac dropsy.

(6) Uro-genital Tuberculosis.

(*a*) Tuberculosis of the Kidneys.—As part of a general diffuse tuberculosis these organs are very frequently affected—more commonly, indeed, than in adults. Usually there are scattered gray tubercles or coarse yellow nodules in the cortical substance. Sometimes, however, the lesion is primary, and one or other kidney is extensively diseased. The affection in these cases appears to begin in the papillæ and calices, gradually invades the substance, and may ultimately destroy the entire organ, converting it into a series of excavations containing a cheesy material. When confined to one kidney, this (known as the *scrofulous* kidney) is sometimes met with in children, the other kidney being healthy and greatly enlarged. When there is extensive tuberculous pyelo-nephritis there is often pain over the kidney; the urine contains pus, very rarely blood. Irregular fever and chills are common. Frequent micturition may lead to the diagnosis of cystitis, with which, of course, it is frequently associated; but it is to be borne in mind that in connection with either calculous or tuberculous pyelitis frequent micturition may be a marked symptom. Sometimes the tuberculous organ is large enough in a child to be palpable. Tuberculosis rarely produces so extensive pyonephrosis as that due to stone.

The diagnosis can rarely be made from calculous pyelo-nephritis except by the detection of bacilli in the urine.

Tuberculosis of the ureters and bladder, very rare as a primary affection, is nearly always secondary to disease of the pelvis of the kidney, sometimes to disease of the prostate.

(*b*) Tuberculosis of the Testis.—Disseminated miliary tubercles may be present in the testicles, but primary tuberculosis of these organs is not at all rare in children. Dreschfeld has reported an instance of congenital tuberculosis of the testis. Many cases have been reported of late years. Of 20 cases by Jullien, 6 were under one year, and 6 between one and two years. Both organs may be affected. The disease most commonly develops in the tunica albuginea or in the epididymis, and may lead to the formation of hard circumscribed tumors. In other instances the process may be more diffuse. When the nodular masses are large the testis may have a dumb-bell or double outline from enlargement of the epididymis. It is a serious affection in children, usually associated with tuberculous disease in other parts. Its existence should always be borne in mind, as in obscure abdominal or thoracic affections the presence of nodular masses in the testicles is of great help in diagnosis. The lesion may gradually heal. The cheesy masses may break down and suppurate, and, forming adhesions to the skin, the pus discharges, and the organ may become much enlarged—the condition formerly known as strumous orchitis.

(*c*) Tuberculosis of the Fallopian Tubes, Ovaries, and Uterus.—These parts are rarely affected primarily in children. It is not very uncommon in generalized tuberculosis to find, even in infants, a double salpingitis.

IV. Prophylaxis.

While the possibility of inherited transmission from an infected mother cannot be denied, we have to face the fact that in a large proportion of all cases of tuberculosis the infection is at the gateways of the body—namely, in the bronchial and mesenteric lymph-glands—and we have here a clue to the two chief sources of danger.

To ensure freedom from contamination through the air the greatest care should be taken to prevent tuberculous patients spitting about in a careless manner. Every part of the expectoration should be carefully collected and boiled, and the patient's handkerchiefs should be thrown into boiling water. The liability of children to infection from this source is very much greater than that of adults, possibly on account of the intimate relations which the child has to the members of the family, more particularly the mother should she happen to be diseased. The habit of young infants, as they creep about, of putting everything in their mouths enhances greatly the liability to contamination.

The second danger to be avoided in children is the use of milk from tuberculous animals. Experiments have shown the readiness with which young pigs and calves become infected when fed on the milk of tuberculous cows. We have, unfortunately, no reason to believe that children are less susceptible than calves. Fortunately, the health authorities have at last awakened to the importance of careful inspection of dairy herds. The safeguard lies in the use of boiled milk, unless the source is known to be free from all possibility of contamination. The infection through meat is probably a very slight danger in a community.

Individual prophylaxis is of almost equal importance. A child born of delicate parents or in a family in which tuberculosis has prevailed should be reared with the greatest care. Very special pains should be taken to guard it against catarrhal affections of all sorts, particularly of the nose and throat, and

on the first indication of mouth-breathing a thorough examination of the naso-pharynx should be made and any adenoid vegetations removed; and if the tonsils are at all enlarged, it is better to have them cut out. The child should live in the open air as much as possible, and the nursery should be thoroughly ventilated, more particularly at night. The meals should be at regular hours, the food plain and nutritious. Every encouragement should be given to take fats, and milk and cream should be used freely. It is a good practice for the mother to sponge the throat and neck of the child night and morning with cold water.

The trifling ailments should be carefully watched. The convalescence from measles, scarlet fever, diphtheria, and whooping-cough should be specially guarded. As the child grows older a systematically regulated exercise or course of pulmonary gymnastics may be taken.

V. Treatment.

Fortunately, a very large proportion of all cases of tuberculosis recover. Many instances of adenitis and disease of the bones heal spontaneously. Even in pulmonary tuberculosis it is remarkable how often we find post mortem evidences of healed lesions, the percentage in some series being as high as 38. In fact, one may say that in a very large number of all cases in which the bacilli find a lodgment in the glands and in the solid organs, the conditions not being favorable, the growth remains local and tends to heal spontaneously. The essential point in the treatment of tuberculosis is the maintenance of nutrition at the highest possible grade. To aid in this three measures are to be practised:

First: A life in the fresh air and sunshine. The importance of environment is well shown in Trudeau's experiments with inoculated rabbits. Those confined in a damp, dark place succumbed rapidly; those allowed to run wild recovered or showed very slight lesions. By far the most important single element in the treatment of tuberculosis of all forms is the constant inhalation of fresh air. The good effects obtained at Göbersdorf, Falkenstein, Saranac Lake, Davos, and Colorado are due primarily to the fact that the patients live a life in the open air and sunshine. Even in cities much can be done by insisting upon open windows night and day, except, of course, in the very inclement seasons. It is an easy matter to protect the patient from draughts, and neither fever, cough, nor night-sweats contraindicate in any way fresh air. This is in reality the very essence of the climatic treatment of tuberculosis; that other considerations, such as moisture, barometric pressure, temperature, etc., are secondary is well shown by the fact that cases of various types of tuberculosis recover completely at places so diametrically opposite as Colorado Springs and Torquay. The regions of high altitudes with low barometric pressure are certainly more stimulating, and, according to Jaccoud, are better for cases of early pulmonary tuberculosis. Cases of bone and gland tuberculosis do remarkably well at the Adirondacks and in Colorado. The level regions with low barometric pressure, such as Riviera, Florida, and Southern California, are reputed to be more sedative in their action and better for tuberculosis in the more advanced grades and with high fever.

The second important measure is feeding, and the outlook in any case, particularly of pulmonary tuberculosis, depends very much upon the stability of the digestive powers. In no way does the open-air treatment do more good than in improving the appetite and digestion. A highly nitrogenized diet, consisting of broths, eggs, milk, and meat, should be taken. In children the milk

diet is particularly to be commended while fever persists. Raw meats scraped, various meat extracts, and peptones may be used when the digestion is feeble. In tuberculous children it is sometimes extremely difficult to manage the diet, and many patients have an aversion to the very articles of food which seem best adapted. Gavage can rarely be resorted to with any advantage in them.

Third, the use of such remedies as cod-liver oil, hypophosphites, and arsenic, which improve the general nutrition. Other measures are frictions, rubbing, and bathing, all of which stimulate and improve the general metabolism.

Treatment directed to the Tuberculous Processes.—The specific treatment by the tuberculin of Koch, which consists of a glycerine extract of the cultures of tubercle bacilli, has been practically abandoned, though the good results obtained in the hands of Trudeau and others with Hunter's modification raise the hope that something yet may be accomplished by its use. Antibacillary medication is as yet unknown, and the introduction of various antiseptic agents by inhalation, subcutaneously, or directly into the local lesion has not been followed by very brilliant results. The direct action of iodoform on local tuberculosis is of great interest, and the remarkable effects in joint tuberculosis should encourage a more widespread use in other forms of the disease. Creasote is a remedy which is believed to have a beneficial action on the tuberculous processes. It probably has no definite antibacillary action, though it is stated to influence powerfully the secondary and associated infections so common in tuberculosis. It seems rather to act as a general nutritive stimulant, improving the appetite, diminishing the fever, and promoting tissue-metabolism and, according to some, sclerotic processes. It is probably at present more widely used than any other single remedy. It has been a favorite with some practitioners for many years, and its reintroduction has been due to the powerful advocacy of Sommerbrodt, Bouchard, and others. It should be given in large and increasing doses, beginning in young children with a minim three times a day, and increasing to five or even ten minims. It may be given in *perles*, or in pills or in mixture; in the latter a convenient way is with tincture of gentian, alcohol, and sherry. As a rule, it is well borne by the mouth. It may also be given in the form of inhalations, the so-called *vapor creasoti* consisting of creasote, 80 minims, light carbonate of magnesium, 30 grains, water to one ounce; a teaspoonful in a pint of water at 140°. Inhalations with this are strongly recommended. Intrapulmonary or intratracheal injections of creasote in oil have been practised. The active principle of it, guaiacol, has been much used, both by the mouth and hypodermatically. Given in solution, it may be made up with tincture of gentian, rectified spirits, and sherry. Hypodermatically, it is used with sterilized olive oil, 5 per cent. solution; 1 or 2 per cent. iodoform may be employed with it, and 1 cc. of the mixture injected, gradually increasing to 3 cc. or even 4 cc. One rarely sees bad effects from creasote: the beneficial results are most marked in individuals who can take large quantities and who can enjoy the associated action of fresh air and a good diet. Creasote without these accessories is not of very great service, as witnessed in ordinary hospital practice. Patients are remarkably tolerant of it, and one rarely sees any ill effects. Other balsamic substances, such as eucalyptol, terebene, terebinthine, thymol, and menthol, have been recommended.

Symptomatic Treatment.—In this we shall refer more particularly to pulmonary tuberculosis.

The fever of tuberculosis is serious and obstinate. It will be found in the early stages that the combination of rest with fresh air is the most beneficial.

The child may be wrapped up and taken into the fresh air for the greater part of the day. We have no thoroughly satisfactory medicinal means for reducing the temperature. Antipyrine, antifebrin, and acetanilide, if used at all, must be given with great care. Quinine and salicylic acid are still used by many practitioners. When the temperature is persistently high in the early stages of tuberculous broncho-pneumonia, cold in various forms will probably be the most efficient measure, and by careful sponging the temperature may be reduced several degrees. The most satisfactory antipyretic is found in the fresh air, more particularly the change to a resort such as the Adirondacks or Colorado.

In the chronic pulmonary tuberculosis of children, when the fever is of a hectic type, sweating is a very troublesome and disagreeable symptom, for which atropine, aromatic sulphuric acid, and tincture of nux vomica may be used. In young children great care should be taken to prevent the chilling of the body after a profuse night-sweat. For the cough, if troublesome at night, paregoric or small doses of Dover's powder may be used. Codeine or, in extreme cases, small doses of morphine may be given. Where there is marked tenderness on the chest or pleuritic complications the cough is sometimes relieved by mild counter-irritation or the application of a warm poultice. Inhalation of terebene and oil of eucalyptus may sometimes diminish the profuse expectoration.

Hæmoptysis in the pulmonary tuberculosis of young children is usually a terminal and fatal symptom, quickly beyond treatment.

The diarrhœa may demand very careful regulation of the diet, and if profuse the acetate of lead, alone or with opium, may be used. Preparations of tannin and gallic acid are also beneficial. In all tuberculous processes there is a more or less marked tendency to anæmia, and many patients improve quickly under the administration of iron. Careful attention should be paid to the gastric symptoms. If the digestion is poor, dilute hydrochloric acid may be used, and if heartburn and pain be present some time after eating, the carbonate of sodium or the alkaline mineral waters.

HEREDITARY SYPHILIS.

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No period of life is exempt from syphilis, which has been aptly styled "the least venereal of the venereal diseases." It is a chronic infectious process, doubtless of microbic origin, the ravages of which are modified by age, conditions of body, and environment. The micro-organism most commonly associated with syphilis as a probable causative agent has been found by Lustgarten within the cellular protoplasm of syphilitic products. He describes it as a bacillus from three to seven micro-millimetres in length, with often a slightly wavy shape. Unfortunately, pure cultures have not been made of this bacillus, and the fact that the lower animals do not contract syphilis prevents the possibility of proof by inoculation.

Syphilis in early life may be either hereditary or acquired. It is not necessary to consider acquired syphilis at length in a work devoted to diseases of children, as it presents no essential differences from the same affection in adult life. It may be well to bear in mind, however, that syphilis detected in infancy is not necessarily inherited, but may be acquired. A primary sore upon the genital tract of the mother may infect the infant during birth, though the possibility of this has been denied. The nurse or attendant may have a primary lesion upon breast or lips. Much more common will be infection from some secondary lesion, especially a mucous patch upon the mouth or lips. There are many ways in which the blood or infective secretions of a syphilitic patient may come in contact with a solution of continuity in the skin or mucous membranes of an infant or child. In such a case a chancre will appear at the point of contact, followed in due time by the after-lesions of the disease. There are certain peculiarities in the effect of the syphilitic virus upon young protoplasm which will be noted under the Morbid Anatomy.

The subject will be here considered under the two heads of hereditary syphilis in infancy, and the taint as it is seen in childhood or when apparently delayed.

Hereditary Syphilis in Infancy.

The disease may be acquired from the father or mother, or from both parents, the poison being lodged in the spermatozoa of the male or the ovum of the female.

Paternal Influence.—While it has been denied by some observers that the father alone can transmit syphilis, the consensus of opinion is in favor of the possibility of such transmission, which can and does take place. The chances of this transmission depend upon certain factors, such as the stage of the disease and the degree of its intensity, as well as the thoroughness with which treatment has been followed. Without mercurial treatment the sperma-

tozoa can usually transmit the syphilitic poison during the first year after primary infection, and there is great danger to the fœtus from syphilitic contagion up to the fourth year. The longer the duration of the disease, the less will be the danger to the offspring, owing to the periods of latency observed during its later stages. If the father be subjected to early and thorough treatment, the probability of transmission of the disease will be much lessened, and such a possibility soon becomes lost with a reasonable lapse of time. If the father infect the mother, as frequently happens, there will be a double syphilization of the offspring, which will probably be stillborn or soon succumb to an aggravated form of the disease.[1]

Maternal Influence.—The influence of the mother upon the growth and development of the fœtus contained within her uterus is obviously very great, and hence when she is suffering from constitutional syphilis the disease is transmitted in an active stage to her child. The degree of such transmission depends, as noted above in the case of the father, upon the stage and severity of the disease and the nature of the treatment employed. During periods of latency the mother may bear healthy children, followed by abortions or syphilitic infants caused by renewed manifestations of the disease. It has been considered that the power of transmission is practically lost at the end of six years. As a general rule, it can be stated that the chances of infection of the fœtus and the severity of the type, if infected, are in direct proportion to the activity of the syphilis in either or both parents. It has been said that if the mother contract syphilis before the eighth month of utero-gestation, she may transmit the disease to the fœtus, although healthy at the time of conception. Dr. Taylor, on the contrary, denies that the syphilis of the mother, acquired during pregnancy, can be conveyed to the fœtus through the utero-placental circulation, as the disease is only communicated either by the sperm-cells or by the ovule diseased at the time of conception. One of the peculiar phenomena seen in connection with infants who are born syphilitic is that the mother may apparently be free from any taint of the disease. It has been a subject of much dispute whether these are instances of latent syphilis or whether the women are really healthy. Whatever the cause, these cases show immunity in contracting syphilis.

In 1837, Colles wrote that "a new-born child affected with inherited syphilis, even although it may have symptoms in the mouth, never causes ulceration of the breast which it sucks if it be the mother who suckles it, although continuing capable of infecting a strange nurse." The substantial truth of this dictum has not been seriously questioned during the many years that have elapsed since its enunciation, although varying explanations have been offered. Fournier states that the inoculation experiments of Caspari and Neumann have proved conclusively that the apparent immunity of the mother, who has borne a child syphilitic by its father, against the contraction of the disease from her offspring, is due to the fact that she has already been infected by syphilis during the intra-uterine period of the child's life. Thus, conceptional syphilis is to be classed with the hereditary form of the disease, since there is here no primary lesion. This form of conceptional syphilis may remain latent for years. Diday advances as an explanation of Colles' law the idea that all infectious diseases may certainly be mitigated to the point of absolute protection by the methodically repeated inoculation of their essential cause (microbic) or of its products (toxic ptomaïnes, etc.). Bouchard considers that while the fœtus retains the supposed pathogenic agent itself, the products dissolved in the blood find their way to the tissues of the mother and set up a nutritive change,

[1] Dr. F. R. Sturgis strongly denies the paternal transmission of syphilis.

resulting in what he calls a "bactericidal condition," which renders difficult or impossible the development of the infectious agent when introduced by later inoculation, as from the lips of her child. The doctrine of syphilis being contracted by conception, sometimes called "choc en retour," although having wide acceptance, is not acknowledged by all. Kassowitz believes that the women who appear healthy and remain so, even after giving birth to syphilitic children, are really free from specific taint.

Syphilis of the Placenta.—Dr. Fränkel in 1873 published a paper in which he affirmed the existence of three forms of involvement of the placenta by syphilis—*i. e.*, endometritis decidualis, endometritis placentaris, and disease of the villous portion of the fœtal placenta. This conclusion was based upon an examination of over one hundred placentæ. Zilles in 1885 published the results of a study of three hundred placentæ derived from Prof. Säxinger's obstetrical clinic. He finds that placental syphilis can often be diagnosed microscopically, and that it oftenest happens in connection with fœtal syphilis. The maternal portion of the placenta or the fœtal part only may be affected, while, again, the whole of the placenta may be involved in the disease. Syphilis is one of the recognized causes of hydramnios.

Morbid Anatomy.—The lesions of syphilis, while always essentially the same, will nevertheless be modified by age. Young protoplasm is active, and usually exhibits a marked reaction to irritative processes, so that the tissues are apt to be extensively involved in hereditary syphilis. The lesions may be broadly divided into those involving the skin and mucous membranes, the viscera, and the bones.

Skin and Mucous Membranes.—The skin may be affected by erythema, maculo-papules, or papules. A vesicular and pustular eruption may occasionally be seen. Blebs or bullæ often appear at birth in a severe type of the disease. Crops of boils, with well-defined, coppery-red bases, are apt to be symmetrically arranged when many are present, or asymmetrically distributed if only a few are seen. The distribution and course of the various eruptions will be noted more at length under Symptoms. In general, they develop quickly and spread over extensive areas of surface on account of the character of infant protoplasm, noted above, as well as from the activity of the circulation in the skin.

The lesions of the mucous membranes may be in the form of catarrhal processes, of mucous patches, or of superficial or deep ulcerations. Any or all of these lesions may involve any part of the alimentary tract or of the respiratory tract. They are seen most commonly, however, in the upper part of these areas, in some part of the mouth or fauces in the former case, and in the nose and larynx in the latter. Still, they may likewise occasionally involve the intestine or trachea and bronchial tubes.

Visceral Lesions.—The viscera are apt to be more extensively involved in hereditary than in acquired syphilis, the lesion being in the form of an interstitial hyperplasia more or less diffuse. Circumscribed gummy infiltrations are not so frequent. The growth of interstitial connective tissue, which gradually contracts, thereby partially obliterating the parenchyma of the organ, may involve the lungs, spleen, liver, pancreas, and testicle.

Lungs.—Usually a portion of a lobe, but occasionally a whole lobe, may present a diffuse fibroid infiltration. The part involved is grayish-white in color and tough in consistency, and surrounded by an inflamed pleura. Under the microscope there is seen to be thickening of the septa and compression of the alveoli by fibrous tissue, which is quite vascular. Occasionally a few rounded masses about the size of a hickory-nut may be noted. These gum-

mata may break down in the centre into puriform matter, but they are not apt to exist in the same subject that the diffuse interstitial inflammation attacks.

Spleen.—The spleen is generally more or less enlarged from a diffuse interstitial hyperplasia. There usually coexists a thickening of the capsule. According to Dr. Gee, the severer the grade of syphilis the greater will be the hypertrophy of the spleen. This enlargement may remain persistent for a long time after other symptoms have disappeared.

Liver.—The liver, which is not infrequently affected, is hardened and enlarged from a diffused sclerosis. Occasionally the affection may be circumscribed. The hepatic cells are compressed and the capillary blood-vessels partly obliterated by the pressure. As in cirrhosis in the adult, section of the liver is accompanied by creaking, and the cut surface presents a yellowish area, interwoven with whitish opaque streaks of fibro-plastic matter. The capsule of Glisson may be thickened upon the surface of the liver, and there may be local peritonitis. Gummata, in the form of small, circumscribed nodules, may be found in the tissue of the liver. They may be seen in association with cirrhosis. These nodules are yellowish, with a tendency to soften in the centre.

Pancreas.—Birch-Hirschfeld has called attention to the fact that there may be hyperplasia of the connective tissue of the pancreas, which on section presents the same fibroid appearance seen in the liver and other visceral organs thus affected. He found in a few cases the head of the organ more involved than the remaining part of the gland.

Testicles.—An interstitial orchitis may affect one or both testicles, producing hardening and slight enlargement of the glands. The hyperplasia may be uniformly distributed through the organ, or the latter may be irregularly involved. The epididymis is not usually affected. Atrophy of the seminal ducts may ensue. Sufficient change in the testicle to be detected clinically is not often seen in hereditary syphilis.

Kidneys.—Parrot has found small tumors, produced by infiltrations of round cells into the connective-tissue stroma, which compress the tubules, and thus cause a colloid degeneration of the contained epithelium. If this process is extensive, it will eventuate in a general atrophy of the kidney. General nephritis may be seen in hereditary syphilis, but it is difficult to say whether the latter is more than a predisposing cause of the former condition.

Heart.—Gummata may be found in the heart. Dr. Coupland has reported a case where the walls of this organ were thickened and hardened.

Bone Lesions.—Waldemeyer, Köbner, Parrot, and R. W. Taylor have shown that various bony lesions are quite common in hereditary syphilis. Many of these lesions, that were formerly referred to rickets or scrofula, are now recognized as syphilitic. There are two principal ways in which the specific poison affects the bones in early life. In one instance the brunt of the disease and morbid change takes place at the junction of the shaft with the epiphysis; in the other, the periosteum covering the long bones is principally affected. Both of these varieties involve principally the long bones.

Osteo-chondritis.—This inflammatory process is induced only by syphilis, and may be the sole manifestation of the taint. The lesion starts in the cartilage joining the epiphysis with the diaphysis, where normal growth in length of the bones takes place; hence deformity of the bone, due to a crippling of its proper development, may ensue. The lesion most commonly affects the bones of the forearm, leg, arm, and thigh, although other bones may be involved, such as the metacarpal and metatarsal bones, the clavicle, sternum, and ribs.

The number of the bones affected appears to depend, to a certain extent,

upon the severity of the general poisoning. It has been found in stillborn infants that most of the long bones may be thus affected, and in those born living, if the bone lesion is multiple, recovery is uncommon. The cartilage affected first becomes thickened and soft from proliferation of cartilage-cells, and there is at the same time lessening of the intercellular substance. This may be felt as a sort of collar-like swelling at the end of the bone affected. The swelling may be visible if the child is not too fat. If, as occasionally happens, one portion or side of the cartilage only is involved, the swelling will be felt not to completely encircle the bone, but as a circumscribed nodule. The disease is apt to be symmetrical and involve the distal oftener than the proximal ends of the bones. There is little change in the integument or surrounding tissues in many cases, as the disease is not apt to extend farther than the bone. In such a case the swelling may remain for a long time, accompanied by little pain or disability. It may originally develop slowly or quickly, and its disappearance will usually promptly follow a proper mercurial treatment. In some cases, however, degenerative changes may ensue, with a breaking down of some part of the swelling. If the morbid process continues, there will be softening, soon followed by ulceration of the skin. If suppuration keeps up, the cartilage will be destroyed and the epiphysis completely separated from the diaphysis. Even in these cases the joint is not apt to be involved, although cases of subacute synovitis, and even pus in the joint, have been reported. If the ulceration is extensive, the epiphysis, when completely separated, may be extruded. When there is destruction of the cartilage and epiphysis, there will of course ensue arrest of growth and consequent deformity in the limb. Parrot has described cases in which the skin remains unbroken after separation of the epiphysis, inducing a condition of paralysis in the affected part. Dr. Taylor describes cases in which, the intervening cartilage having been destroyed, the epiphysis is united to the shaft only by fibres of periosteum. This membrane may become much thickened, and form a more or less complete cylinder, uniting the two fragments with considerable firmness. Bony spiculæ shoot from its inner surface between the two osseous surfaces, and thus eventually bony union is secured. The swollen periosteum may gradually resume a more nearly normal thickness.

Osteo-chondritis develops early in life, usually within the first month. The lesion may, however, occur later, when it is not apt to become multiple, and may be unsymmetrical in distribution. The question as to whether certain epiphyseal swellings may be due to syphilis or rickets will possibly arise. Other lesions of these two diseases will have to be sought after in order to aid in making a correct diagnosis. Such swellings are pretty surely syphilitic if they occur during the first six months of life, and at all times are relieved by mercurial treatment. Again, the epiphyseal swellings of rickets are always symmetrical, while those of syphilis may be unilateral.

Periostitis.—This form of lesion occurs later in hereditary syphilis, usually after the child has begun to walk. It attacks by preference the femur, tibia, and bones of the forearm, occurring usually from the second to the fourth or fifth year. There is more or less enlargement of the affected bone. At an early stage of the disease the bones are attacked symmetrically, but later circumscribed nodes may be placed unilaterally.

Dactylitis.—The phalanges and the metacarpal and metatarsal bones may be enlarged to several times their natural size. After an interval of time the skin may become inflamed and break down from the formation of an abscess. The proximal phalanges are more apt to be attacked than the distal, and several bones of each hand may be affected. There is not much destruction of

bone, even in severe cases, and, although the disease tends to run a slow course, it is always influenced favorably by treatment. Dactylitis is apt to occur in very young subjects, when it takes the form of a gummatous infiltration. (Fig. 1).

FIG. 1.



Syphilitic Dactylitis.

Craniotabes.—The local thinning of portions of the cranial bones was formerly attributed exclusively to rickets, but is now known to ensue as well in the malnutrition accompanying syphilis. As it is due to pressure of the thin skull between the brain and pillow, it is especially apt to involve the occipital bone. Carpenter considers that both craniotabes and Parrot's nodes are often syphilitic manifestations, although they are more frequently regarded as evidences of rickets: 74 per cent. of cases of craniotabes are syphilitic, according to this author.

Symptoms.—The symptoms of hereditary syphilis vary widely according to the extent of the poison. When the virus is concentrated, as in cases where both parents are syphilitic, the fœtus will be attacked by the disease in the uterus, and, as a result, we shall have abortion more or less early in the pregnancy. As the disease abates in one or both parents the pregnancies will be longer in duration, until finally apparently healthy infants may be born.

In some cases the infant will present marked evidences of syphilis at birth; often, however, the onset is delayed until later, and at birth there may be absolutely no manifestation of the disease. In 158 cases analyzed by Diday the first manifestation of symptoms occurred in 86 cases before the completion of one month; in 45 before the completion of two months; and in 15 before the completion of three months after birth. The remaining 12 cases showed the symptoms in intervals varying from four months to two years.

The earlier the disease manifests itself after birth, the graver will be the nature of the attack. Very early syphilis is usually accompanied by emacia-

tion, eruptions of bullæ, particularly upon the palms of the hands and soles of the feet, and an extreme degree of coryza, cracked and ulcerated lips, and evidences of visceral and bony disease. In the older cases there may be no interference with nutrition, and possibly one or two mucous patches may be the only active manifestation of the disease. In studying the symptoms it may be well to consider the disease as it shows itself in different structures and areas of the body.

Skin.—One of the early symptoms appearing upon the skin will be the eruption of small round pink spots, disappearing on pressure, and usually appearing first on the lower portion of the abdomen. It may spread from this location and finally involve the whole body. Pigmentation of these spots may ensue, and they may present a dark-red, coppery discoloration. This latter change may be considered as having a diagnostic value. In hereditary syphilis the rashes often develop rapidly, and are apt to be less symmetrical than those seen in adults. They are likewise polymorphous, as several different forms of syphilide may be exhibited at the same time in a given case. A papular syphilide may be seen in the form of small or large flat papules, symmetrically distributed over the surface. These papules are not so apt to group themselves into lines and circles as in older subjects with syphilis. They are not so solid and deeply infiltrated as in the adult. Upon the palms and soles these papules may be very abundant and fuse together, presenting a thickened, dull-red surface. The vesicular syphilide is not common, and when seen is apt to be in very severe cases. The vesicles may be associated with pustules, and appear in closely-arranged groups about the mouth or chin or various other parts of the body, especially the nates and hypogastrium. Pustules may form, especially on the face, buttocks, and thighs. The ulceration is deeper and the crusts darker in color than in impetiginous eczema. Pemphigus likewise appears in the severe forms of the disease. It most frequently attacks the palms of the hands and soles of the feet; it may have a copper-colored areola and develop rapidly. Crops of indolent boils, symmetrically distributed and of a copper-red color, may appear in connection with other eruptions. They are more apt to be seen in badly-nourished infants. In some cases the only appearance of syphilis upon the skin will be a smoky discoloration, seen most distinctly in the prominent parts of the face, such as the eyebrows, cheek-bones, and bridge of the nose. The nutrition of the skin is much affected in cases where the cachexia is marked; it hangs in dry, loose folds, having an unhealthy, earthy appearance.

Mucous Membranes.—The mucous membranes, as well as the skin, present the earliest manifestations of the disease. One of the most typical lesions is the coryza, which may be the first symptom noted. First, there may be a serous discharge which attracts little notice; this, however, gradually becomes worse, and the nasal secretion takes on a purulent or even a bloody character, and may be sufficiently irritating to cause excoriations of the upper lip. The mucous membrane itself becomes thickened, and the inspissated secretion soon dries, forming crusts, which may completely block up the passage through the nostrils and seriously interfere with nursing. The secretion may likewise be offensive. In severe cases, particularly where cleanliness is not practised and the decomposing secretions are allowed to remain in the nostril, there may follow ulceration of the mucous membrane, and possibly even necrosis of the adjacent bony parts. There is apt to be a flattening of the bridge of the nose, probably, to a certain extent, due to the interference with normal respiration. The inflammation may spread to the pharynx and larynx, although its action is likely to be limited to the Schneiderian membrane.

Mucous patches will be seen in most cases of hereditary syphilis, and, although they appear most constantly on the mucous membranes, they may be present upon the skin, particularly at its junction with the mucous membranes, or upon those parts which are thin and exposed to various secretions. They may occasionally be seen on any part of the cutaneous surface of the body. They are oftenest seen in the mouth, about the nose, upon the scrotum, vulva, labial commissures, and occasionally at the umbilicus. In the mouth the most frequent situations are upon the angles of the lips, inside of the cheeks, the pillars of the fauces, the tonsils, and the sides and dorsum of the tongue. They consist, in the early stage, of a slightly raised segment of mucous membrane, presenting a whitish surface and red margins. This may soon ulcerate. When the mucous patches appear at the angles of the mouth, deep fissures will often form at the corners of the lips, extending sometimes well out into the cheek. These fissures are sometimes called rhagades, and are diagnostic. The secretions on these mucous patches are very infective. When mucous patches appear on the cutaneous surface, they are slightly raised, with a macerated appearance, and frequently seamed with erosions or cracks. In the late stages of hereditary syphilis mucous patches are not so numerous as in the earlier stages of the disease, but they frequently recur after the child is apparently restored to health.

Disturbance of Nutrition.—The extent to which the general nutrition of the infant is disturbed will depend upon the severity of the attack. In grave cases there is atrophy of all the structures of the body, the infant presenting a weazen appearance, with a countenance resembling that of an old man. These cases are almost invariably fatal, and are caused by the blighting influence of the virus. In many cases, however, a failure of nutrition will ensue gradually, consecutive to gastro-intestinal disturbance. This may be due to actual specific disease of the liver, stomach, or intestines, or it may be due to indigestion and malassimilation only indirectly caused by feebleness from the cachexia. In bottle-fed babies digestive disturbances are marked and severe, infants upon the breast being much less liable to suffer. In some cases the infant will present very slight disturbance of the general nutrition, being plump and well-nourished throughout the course of the disease, which may be only manifested by mucous patches or mild evidences of the infection.

Condition of the Blood.—A condition of profound anæmia is frequently seen, particularly in severe cases. Johann Loos states that hereditary syphilis is always associated with an anæmia which under some conditions may reach an extreme degree of intensity. This anæmia is characterized by a diminution in the number of the red blood-corpuscles, by quite a marked alteration in these corpuscles, the appearance of megalocytes and microcytes, and by the appearance of nucleated erythrocytes, sometimes in quite notable quantity. It is always characterized by the constant existence of leucocytosis, which may often become extreme, and by the appearance of myelo-plaques in the blood. This anæmia is a very important and significant symptom of the disease, and may directly occasion a fatal issue. He further states that there are only two diseases common to childhood in which the lesions of the blood suggest the changes just described, and these are splenic anæmia and severe forms of rachitis.

A form of syphilis hæmorrhagica neonatorum has been described by Bumstead and Taylor. There may be simply a limited subcutaneous effusion, or the mucous membranes may be the seat of the hæmorrhage. Hæmorrhage at the umbilicus shortly after birth may be due to this cause.

Glandular Enlargements.—General adenopathy is not seen in the hereditary

form of syphilis. There may be enlargement of the chains of cervical glands consecutive to lesions in the adjacent mucous membranes, and occasionally there may be an affection of the inguinal, axillary, or cervico-maxillary glands without any deeper lesions being noted to account for their existence by septic absorption. The glands are hard, moving without pain in the areolar tissue under pressure by the finger. Some writers consider that enlargement of the epitrochlear glands is pathognomonic of congenital syphilis, but well-marked cases occasionally fail to show this sign upon careful examination.

Bony Organs.—The frequency with which the bones are involved in hereditary syphilis has been noted in the morbid anatomy of the disease. In every case the long bones should be carefully examined for enlargement and thickening at the epiphyseal and distal ends. In cases where suppuration has taken place the epiphysis may be separated from the shaft, and crepitation will then be found upon careful handling. The joint itself may occasionally be involved in the inflammation, showing the well-known symptoms of arthritis. Where the bones are much affected there will be some disability of the limb, possibly extending to complete paralysis. Immobility in such a case is without doubt due to the affection of the bones.

Dactylitis.—In the early period of the disease an enlargement of the phalanges is frequently seen, and occasionally also of the metatarsal and metacarpal bones. The proximal phalanx is more frequently attacked than the distal; the affection may spread to all of the phalanges, but is more apt to involve only one, which may be enlarged to double its normal size. This enlargement is the result of specific inflammation of the bone and periosteum, and runs a slow course unless modified by specific treatment. There is not apt to be much involvement of the soft parts; the integument will be reddish and inflamed, but there is little tendency to suppuration and ulceration. These swellings usually present a fusiform shape, with a hard, firm sensation to the touch.

Teeth.—The appearance of the deciduous teeth is delayed in hereditary syphilis, as in rachitis. The first teeth may not appear until the tenth or twelfth month, or even later. These teeth are poorly developed and apt to undergo early decay. There is usually a similar delay in the appearance of the second teeth, which present more pathognomonic changes, which will be noted in connection with late hereditary syphilis.

Nervous Disturbances.—Lesions of the nerve-centres do not often appear in hereditary syphilis; there may be, however, an occasional palsy due to a peripheral cause. One form in connection with bony lesions has already been mentioned. There may be contractures and paresis, however, where no bony lesion can be noted. Henoch questions whether such affections may not be myopathic in their origin and independent of the nervous system.

The following case coming under my observation illustrates a case of paralysis evidently caused by interstitial syphilitic myositis: An infant four weeks old, whose mother presented syphilitic lesions, was born healthy at full term. When seven days old it was noticed that the right leg was drawn up and apparently did not move; also the right arm. There was complete loss of power in these members; there was wrist-drop, and a loss of faradic and galvanic irritability in the extensors of the left wrist. The muscles affected were rather hard and painful to the touch. There was an enlargement at the epiphyseal end of the left humerus. The paralysis completely disappeared in about two months under specific treatment.

Dr. Eustace Smith states that a form of real paralysis has been occasionally seen affecting the branches of the brachial plexus, causing more or less complete loss of power in the arm.

Onychia.—Two kinds of onychia are noted in hereditary syphilis—the ulcerative and the nutritive. In the ulcerative form the pustule appears at the margin of the nail, which soon breaks down, leaving a sloughy surface, which may destroy the matrix. The surrounding skin presents a coppery discoloration. In the nutritive form, which is apt to appear later, the ulcer has a sloughy base, and presents a swelling around the periphery of the nail, which becomes thickened and brittle. Swelling and deformity of the phalanx may ensue. In a case recently observed, a child of two years, whose father had a specific history, presented immense bulbous masses upon the extremities of the thumb and middle finger of the right hand and the thumb and fore finger of the left hand. These were granular, warty masses about the size of hickory-nuts, with the nail protruding backward. When the infant was eight months old it appeared healthy, except that the finger-nails now involved were like claws and were reddened as if scalded. The trouble had continued until the nutritive changes produced the enlarged mass here noted. There had been a history of "snuffles," abscesses on the buttocks, sore lips and gums, but at the time of the examination the only other manifestation of the disease was a large mucous patch in front of the scrotum. In the nutritive form of onychia the hyperæmia of the matrix and the deformity of the phalanx, if not extreme, may disappear under specific treatment.

Iritis.—This is an exceedingly rare affection in hereditary syphilis, but cases have been reported by Mr. Hutchinson in infants varying in age from six weeks to sixteen months. It does not differ from the same manifestation in adults.

Alopecia.—There may be loss of hair in the scalp, eyebrows, or eyelashes. The last form is the most pathognomonic, as there may be a deficiency in the nourishment of the hair of the scalp in rickets or any condition of cachexia in infants.

General Irritability.—Syphilitic infants are very fretful, and the cry is of a peculiar high-pitched character. This fretfulness is particularly apt to be present at night, at which time the child is extremely wakeful. In this, however, it does not differ much from rickets.

Diagnosis.—A difficulty in the diagnosis of hereditary syphilis may obtain where typical lesions are not well marked, or where it is a question between syphilis and scrofulous or tubercular lesions. In cases of marasmus, if there is no history of chronic indigestion, particularly if the infant have been fed at the breast, there is strong suspicion of syphilis. A careful examination for mucous patches will often throw light on such a case. Chronic coryza is likewise a valuable sign in diagnosis.

The following points of distinction between syphilitic and scrofulous lesions of the skin have been given by Dr. P. A. Morrow: (1) Syphilitic lesions are general in their distribution; they may occur upon any region of the body. Scrofulous lesions are more limited in their localization; they have a special predilection for the neck or regions rich in lymphatic glands. (2) Syphilitic lesions are ambulatory and changing; they disappear and reappear elsewhere. Scrofulous lesions are fixed and permanent. (3) The color of syphilitic lesions is reddish-brown or "lean-ham" tint. The color of scrofulous lesions is brighter and more violaceous in hue. (4) Syphilis is distinct from scrofula in its objective appearances and mode of evolution. In the initial stage the syphilitic neoplasms are firm and hard; the scrofulous infiltrations are softer and more compressible. In the ulcerative stage the differences are more pronounced; the ulcers of syphilis are cleaner cut, regular in contour, with perpendicular, firmly-infiltrated borders encircled by a pigmented areola;

scrofulous ulcers are irregular, with soft, undermined borders; they are painless, bleed easily, and show slight tendency to spread. (5) The crusts of syphilis are bulkier, thicker, with a tendency to accumulate in layers, and darker in color; the cicatrices are smooth and remain long surrounded by a pigmented areola. The crusts of scrofula are softer, more adherent; the cicatrices are elevated, irregular, bridled; they retain their violaceous color for a long time. (6) The course of a syphilitic ulcer, though sluggish and chronic, is much more rapid than that of scrofula. (7) Absence of pain and local reaction characterize both syphilitic and scrofulous ulcers; they are essentially lesions without symptoms.

In connection with the bony lesions it is important to diagnose between syphilis and tubercular and rachitic affections. The following points in diagnosis between syphilis and tuberculosis are given by Dr. Morrow: (1) Syphilis exhibits a marked predilection for the long bones; its habitual localization is in the diaphysis, and almost always at its terminal extremity. Tuberculosis is almost exclusively situated in the epiphyses, rarely affecting the shaft. (2) In syphilis there is a marked enlargement of the bone by more or less voluminous osseous tumors or hyperostoses, with little or no involvement of the soft parts; and in tuberculosis the tumefaction is due less to increase in the size of the bone than to œdematous infiltration of the soft structures. (3) In syphilis there is little tendency to suppuration and necrosis; in tuberculosis the pyogenic tendency is marked. (4) In syphilis osteocopic pains, with tendency to nocturnal exacerbation, are a pronounced feature; in tuberculosis the pain is dull and heavy, not aggravated at night; sometimes there is entire absence of acute painful symptoms. (5) The osseous lesions of syphilis rarely react upon the general system, while those of tuberculosis often determine a marked impairment of the general health, grave complications, hectic fever, cachexia, etc.

In syphilitic dactylitis there is little involvement of the soft parts, the swelling being caused by the enlargement in the size of the bone. In tubercular dactylitis the swelling is due more to an œdematous infiltrated condition of the soft tissues than to enlargement of the bone. In the latter cases breaking down of the tissues and ulceration are more apt to ensue.

The diagnosis between syphilis and rickety bone-lesions may be of great importance. Epiphyseal swellings occurring under six months are very apt to be syphilitic. In syphilis the epiphyseal swelling may be unilateral, but it is always symmetrical in rachitis. In doubtful cases the swelling must be subjected to specific treatment. It is well to remember, however, that rickets and syphilis may coexist in the same case. There is almost invariably enlargement at the costo-chondral articulations in all cases of rickets, which is absent in syphilis.

Prognosis.—According to Kassowitz, one-third of all syphilitic children die before their birth, and among those who are born 34 per cent. die in the first six months of life. Fournier places the mortality, when derived from the father alone, at 28 per cent.; from the mother alone, 60 per cent.; when from both parents, 68½ per cent. The earlier the symptoms appear after birth, the severer will be the type of the disease and the worse the prognosis. Involvement of the bones and viscera means a severe type of the disease. Infants fed upon the breast will have a much better chance than those artificially fed. In bottle-fed infants, particularly when the disease appears early, the prognosis is almost always fatal; it is invariably so in hospitals and lying-in institutions. Any interference with digestion and assimilation, no matter from what cause, will necessitate a guarded prognosis. If the coryza is extreme and breathing much disturbed, the prognosis must be altered in proportion to the amount of

such disturbance, which interferes with rest and the taking of food. If the digestion remains good, and particularly when the manifestations of the disease are not severe, complete recovery takes place, and the infant may grow up healthy and strong.

Late Hereditary Syphilis.

In some cases of hereditary syphilis the manifestations of the disease during infancy may be exceedingly mild, and, in fact, overlooked. It is possible in such a case that the poison may show itself in various ways during the period of childhood. "*Syphilis tarda*" is a term applied to those cases in which the first manifestations of hereditary syphilis appear in childhood. The existence of such a condition without any earlier evidence of the disease has been disputed. It is analogous to the discussion as to whether syphilis in the adult may present late secondary or tertiary symptoms without being preceded by earlier lesions.

Late hereditary syphilis may manifest itself either in certain active lesions plainly to be attributed to this condition, or by certain developmental defects that may easily be confused with scrofula, tuberculosis, or rickets. It may be well for us to note some of the more characteristic lesions.

Bone Affections.—One of the commonest manifestations is a periostitis involving various long bones, especially the tibia, the ulna, the radius, and the humerus. Accompanying this periostitis there may be considerable thickening upon the surface of the bone, sufficient to induce a change in its form. The lesion may be multiple and symmetrical, although occasionally unilateral. It is attended often with little discomfort aside from occasional nocturnal pains. The nasal bones may be affected, producing much deformity by destruction of the bony arch of the nose. In many cases not so severe there is marked flattening of the bridge of the nose and a wide separation of the eyes. The frontal bone is apt to be large and flat, with prominences somewhat exaggerated. There is also usually a very high palate arch. Dactylitis may be seen in this late stage of the disease, and sluggish swellings of the metacarpal and metatarsal bones. The secondary teeth are affected in a way that has been considered pathognomonic. As is well known, Mr. Jonathan Hutchinson first called attention to this condition. The principal change is noted in the two superior middle incisors, which are small, peg-shaped, and placed at such an angle that the cutting borders, if continued, would meet. They may occasionally be deflected outward, as in the accompanying illustration. (Plate V.) The cause of this maldevelopment has been explained by Fournier as due to defective growth within the alveolus, while Hutchinson refers it rather to an early stomatitis or an alveolar periostitis often present during infancy. The incisors are apt to be notched at the lower edge, as is well shown in the plate, which is taken from a case under the care of Dr. Stowell. The enamel is usually eaten away in this portion of the teeth. Dr. John N. Mackenzie has called attention to ulceration of the palate, which is apt to take place in the centre, and be followed by caries or necrosis of the bone. There may be simultaneous or consecutive deep ulceration of the palate, pharynx, and naso-pharynx at any time previous to the age of puberty. Large and indolent mucous patches may be present upon the cheek, tongue, gums, and especially about the corners of the mouth. The ulceration about the lips may leave long scars, particularly to be seen at the commissures of the lips. This is most beautifully shown in the accompanying illustration of Dr. Stowell's case. (Plate V.)

PLATE V.



HUTCHINSON TEETH.



FISSURES, OR RHAGADES.

(From Dr. Stowell's Case.)

Kidneys.—Fournier considers that chronic degenerative changes may take place in the kidneys, usually in the form of a parenchymatous nephritis and amyloid degeneration.

Interstitial Keratitis.—There is frequently noticed an opacity of the cornea without much congestion of the conjunctiva. The opaque areas may, in severe cases, coalesce, and cover the whole cornea. Although primarily attacking one eye, it soon involves the other. There may coexist an iritis, presenting symptoms which are indolent in character without the severe pain and photophobia so often seen in many cases of iritis. It may be difficult to recognize the existence of iritis when the cornea is opaque from the presence of abundant interstitial keratitis. Deeper-seated troubles, such as choroiditis and retinitis, may occasionally occur.

The Genitalia.—Occasionally a painless enlargement of one or both testicles may be noticed, accompanied by a slight degree of hydrocele. This condition may sometimes involve the epididymis and the cord. When the testicle is thus involved, there are apt to be syphilitic lesions in other parts of the body, which will aid in diagnosis. In many cases all the evidence of syphilitic taint in childhood will be seen in arrested and perverted development. Such a child exhibits in its growth much retardation of development in comparison with other children of the same age. This may be particularly seen in the genital organs, the testicles at puberty being the size seen in very early childhood, and in girls an absence of mammary development, delayed menstruation, and a non-appearance of hairs on the genital and axillary regions. Fournier has given the name "infantilism" to this defective physical and mental development. Such cases not infrequently develop epilepsy.

The Treatment of Syphilis.

The dictum of Dr. Holmes that the proper treatment of some diseases should be begun one hundred years before birth may be modified, in syphilis, to a treatment existing several months before birth. There is no doubt that parents who exhibit any specific symptoms or who have had syphilitic children should be subjected to constant specific treatment and oversight. Such treatment may avoid miscarriage, and possibly prevent the development of syphilitic disease in the infant. The treatment of the syphilitic infant resolves itself into specific medication directed to the actual poison of the disease and to means aimed to prevent the collateral loss of nutrition which is so common and so grave in these cases. Mercurial treatment may be applied by external or internal medication. The former is particularly adapted to cases where infantile diarrhœa and indigestion may, to a certain extent, contraindicate the internal use of mercury. Daily inunctions of mercurial ointment mixed with from four to eight times its quantity of vaseline or rose ointment are efficacious. It may be rubbed on the inside of the thighs or in the axillæ, using a portion about the size of a small hickory-nut. Or the ointment may be applied on a flannel roller and bandaged about the child once a day. Before applying the ointment in this way the skin must be cleansed thoroughly with soap and tepid water. A little more cleanly method of local medication consists in applying five drops of a 10 per cent. solution of the oleate of mercury three times daily. It is certain that under external applications the specific lesions will frequently disappear.

It is probable, however, that it will be found, as a rule, more satisfactory to employ internal medication. Mercury with chalk is one of the best preparations, in doses of one-fourth of a grain to one or two grains twice a day. Dr.

Jacobi prefers calomel, on account of the rapidity of its action, in doses of from $\frac{1}{20}$ to $\frac{1}{6}$ grain three times a day. Bichloride of mercury has many adherents. The liquor of Van Swieten is the form recommended by Parrot for internal administration. The formula is as follows:

℞. Bichloride of mercury . . . . . 1 part.
Water . . . . . 950 parts.
Rectified spirits . . . . . 100 parts.
Sig. 5 to 20 drops in milk three times a day.

The bichloride of mercury may be given in simple watery solution, which may be combined with milk, and hence readily taken by the infant. The dose varies from $\frac{1}{200}$ to $\frac{1}{60}$ of a grain, according to the age and condition of the infant. If intestinal irritation be caused by the drug, a mixture of wine of pepsin and elixir of bismuth may be used as a menstruum.

An important element in the management of these cases will be the local treatment, applied to mucous patches, excoriations, and especially to the coryza. Ulcerations and destructive processes in the nose may be largely avoided by keeping the nasal passages clean by tepid water or bland oil. A 2 per cent. solution of the oleate of mercury will be efficacious in the nose. Mucous patches or condylomata should be kept clean, and may be dusted with calomel and bismuth. Nitrate of silver may be applied to patches appearing in the mouth that are intractable to internal treatment.

Where the bones are involved and evidence of gumma in any portion of the body is present, iodide of potash should be employed. In the visceral lesions this remedy likewise acts well; and if the indications arise, mixed treatment, by combining the biniodide of mercury with iodide of potassium, may be employed. The iodide of potassium is most efficacious, although the iodide of sodium may be administered with good results. The dose should be moderate, not averaging more than a few grains.

The general care of the nutrition of the syphilitic infant is most important. The chances for maintaining good nutrition are much improved by keeping the baby on its mother's breast. If the mother is unable to entirely supply the infant with nourishment, the bottle may be employed, but never to the complete exclusion of the breast. The well-known fact that an infant cannot infect the mother, although the latter shows no evidences of syphilis, justifies us in insisting upon her nursing her own infant. The employment of a healthy wet-nurse, although of advantage to the infant, is not justifiable, as the former will almost surely be infected by the latter. After nursing, the nipple should always be carefully cleansed, as well as the infant's mouth, by the use of some bland disinfectant solution. In cases in which the infant is deprived of the breast the most scrupulous care and cleanliness must be exercised in artificial feeding. A mild form of indigestion will severely handicap the syphilitic infant, and may eventuate in its death. General tonic treatment and stimulation may be employed in connection with specific treatment.

The treatment of the later forms of syphilis will depend upon the activity of the morbid process. Mercury should always be exhibited in some form when there is any evidence of active syphilitic disease. It has been proven that small and proper doses of mercury are tonic in syphilis, and actually relieve the hydræmia and defective nutrition so often seen in this disease. If there is no evidence of an active syphilitic process, the treatment will resolve itself into improving the nutrition of the child in every way. Good food, tonics, iron, cod-liver oil, change of air when possible, are all of value in aiding healthy growth and development in these retarded cases.

PART III.

THE ACUTE INFECTIOUS DISEASES.

MEASLES.

By LOUIS STARR, M. D.,

Philadelphia.

Rubeola is an acute, infectious disease, characterized by coryza and other catarrhal symptoms, by continued fever, and by an eruption of slightly elevated, crimson papules upon the face and body, followed by furfuraceous desquamation.

It is perhaps the commonest of the infectious diseases of childhood, and very few individuals arrive at adult age without having suffered from an attack. One attack usually protects against a second, though instances in which there have been two, or even three, attacks are not rare.

In large cities scattered cases of measles may be encountered at almost any time, but at certain recurring intervals, varying from eighteen months to two years, the disorder becomes epidemic. These epidemics are alike in the fact that young children, being unprotected by a previous attack, uniformly suffer most; unlike, in the extent of their prevalence, in fatality, and in the accentuation of particular symptoms. In isolated localities, having infrequent communication with large centres of population, and where measles has prevailed only at long intervals, the disease when it does arise finds a greater number of victims, attacks a larger proportion of adults, and is more fatal. When introduced to a virgin soil the virulence is extreme. As an instance of this the four months' epidemic of 1875 in the Fiji Islands may be cited: during it 40,000 natives died out of a population of 150,000—upward of 1 to every 4 souls. By contrast, the mortality in London in 1886—an average year—was 1 to each 2000 of the population.

Etiology.—The prime cause of the disease is a specific poison, the nature of which has not been determined, though A. Ransome and Braidworth and Vacher have discovered, in the breath and secretions of measles patients, certain peculiar organisms identical with those to be described as existing in the skin, the lungs, and the liver. It is certain, however, that the poison spreads by contagion, and most probable that, whether or no these micro-organisms carry it, it is given off in the breath and secretions. The contagion is usually conveyed directly from the sick to the well, and is so virulent that when once introduced to a dwelling or hospital ward its spread is rarely stopped until all unprotected inmates suffer. It may be carried from place to place by fomites, but simple airing of the clothing is usually sufficient to disinfect it. When such instances of infection occur close connection is shown, the medium being a child or nurse coming directly from an infected house. Experimentally, the disease has been propagated by inoculation with the blood, the nasal and bronchial mucus, and the tears of a patient, and also

with the serum taken from the vesicles which occasionally accompany the eruption. Infection begins in the incubative stage, is most active during the pre-eruptive period of coryza and fever, continues throughout the eruption, and thereafter rapidly subsides, to disappear at the end of the third week.

No age of infancy or childhood is exempt from measles. It may occur in sucklings a few weeks old, but is uncommon during the first six months of life. The period of greatest susceptibility is between the second and sixth years.

According to some authorities, males are more prone to be attacked than females, but the disproportion between the two sexes is insignificant. Season, too, seems to have little influence in furthering the onset of the disease. If there be any difference, it is in favor of the damp, changeable, depressing weather of March, April, and early May. In the Children's Hospital of Philadelphia, for example, scarcely a year passes in which there is not a more or less extended epidemic during these months. Apart from unknown atmospheric causes, the explanation may be found in the fact that at this season children are below par, or impaired in health by the disorders and confinement incident to the winter months, and therefore less able to resist the contagion which is always latent in large cities.

Pathology.—When death comes early in the course of the disease from the force of the poison itself, an autopsy reveals hypostatic congestion of the lungs, hyperæmia of the mucous membranes, and congestion of the organs generally, with extravasation into their substance, and softening. The blood is fluid, dark-colored, and deficient in fibrin.

During an epidemic at the Philadelphia Hospital, Drs. Keating and Formad detected large numbers of microbes in the liquor sanguinis and white corpuscles of blood taken from malignant cases, and the author has since made the same observation. Quite recently, too, a bacillus has been discovered in the urine of rubeolous patients. What relation these organisms bear to the disease cannot yet be definitely asserted. In sections of skin made on the sixth day of the eruption Braidworth and Vacher found swelling of the chorium and thickening of the rete Malpighii, due to great proliferation of cells which extended along the hair and sweat-ducts into the glands. Sparkling, colorless, spheroidal, and elongated bodies were also present in the true skin next to the rete, in the lungs, and in the liver. In each situation these bodies were mixed with others, spindle-shaped, staff-shaped, and canoe-shaped; all appeared to be albuminoid in character.

Other morbid appearances vary with the complications upon which death so frequently depends. The most common lesions are those of diffuse bronchopneumonia and of structural alterations of the mucous membrane of the gastro-intestinal tract, either catarrhal inflammation, follicular entero-colitis, ulcerative inflammation, especially of the colon, or softening. Less frequent are caseation of the bronchial glands, miliary tuberculosis of the lungs, pulmonary collapse, membranous laryngitis, diphtheria of the pharynx, and effusions into the pleuræ and other serous cavities.

Incubation.—The interval between the actual introduction of the poison and the appearance of the first symptoms of illness has been quite accurately determined—first, by experiment, measles having been introduced by inoculation in Edinburgh, Italy, and Germany; second, by the careful study of outbreaks in virgin soil, such as that in the Faröe Islands, by Panum; and third, by ordinary clinical observation. From all these sources the period may be fixed at from ten to twelve days.

Adults and older children may complain of distaste for food, slight head-

ache, and lassitude for several days before the actual beginning of the disease, but younger children appear to be perfectly well, and practically there are no symptoms during incubation.

Symptoms.—The course of rubeola may be divided into several stages.

Prodromal Stage.—This lasts about four days, and is characterized by the following group of symptoms: lassitude, irritability, at times chilliness, pain in the back and limbs, headache, loss of appetite, thirst and other indications of gastro-intestinal disturbance, and, more important, fever, with the various signs of catarrhal irritation of the mucous membrane of the eyes, nose, fauces, and larynx. The chilliness is not marked, rarely amounting to more than a disposition on the part of the patient to keep near a fire or a desire for more clothing, and a degree of coolness in the extremities appreciable to the nurse's hand. The same may be said of pain in the back and limbs, its presence in older children being established only by close questioning, and in younger by their showing indications of suffering when moved.

Pyrexia is uniformly present. It may be postponed until the second day of the prodromal stage, but usually begins on the first. The fever is continued in type, the *ascent* of temperature being marked by evening exacerbations

FIG. 1.

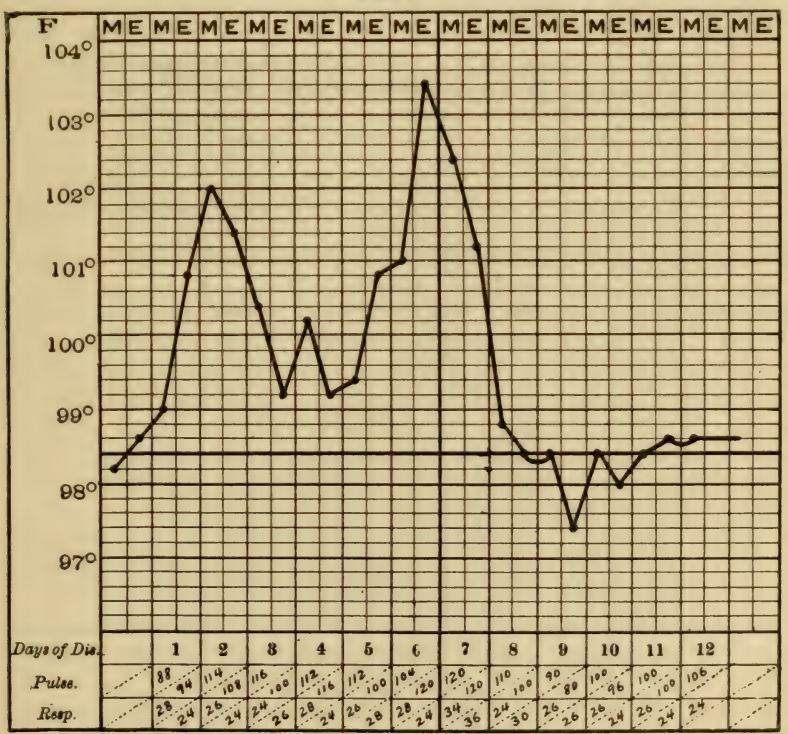


Chart of Temperature in Measles, showing Pre-eruptive Rise.

This chart was taken from a negro boy æt. eight years, a patient at the Children's Hospital, Philadelphia. The attack of measles began on the day marked 1; the eruption was detected on that marked 5, and was at its height on 5 and 6.

(about 2°) and morning remissions (about 1°), which show a tendency to become less decided and shorter as the day of eruption is approached. Sometimes there is a marked remission or complete intermission on the second or third day, after which the temperature curve pursues the ordinary course. (See Figs. 1 and 2.)

With the rise in temperature the pulse becomes increased in frequency, force, and volume, though it is rarely as frequent as in scarlet fever. The skin, while moist, feels hot; complaints are made of frontal headache; and the child, at first irritable and restless, gradually passes into a condition of quiet and drowsiness, when it is said to "sleep for the measles."

The pathognomonic catarrhal symptoms begin with, or even precede, the pyrexia. These are inflammation and redness of the conjunctivæ—the palpebral portions especially—injection of the whites of the eyes, photophobia, lachrymation, stuffing of the nose, sneezing, and an abundant discharge of muco-purulent fluid from the anterior nares. The secretions from the eyes and nose are irritating and excoriate the skin over which they flow; the redness thus produced, with the injection of the eyeballs, the swelling of the lids and face generally, make up a heavy, almost characteristic, physiognomy.

Cough is usually present from the first day. Slight and infrequent in the beginning, it gradually increases, until on the third or fourth day it assumes a peculiar character. It is laryngeal, hard, dry, rather hoarse, and occurs in short paroxysms. Expectoration, when present, is slight and consists of clear, viscid mucus. The voice is hoarse.

The tongue is covered with a light white coating; the tonsils are moderately enlarged; the mucous membrane of the soft palate, fauces, and pharynx is uniformly swollen and reddened, and from twelve to twenty-four hours before the close of the prodromal period often becomes maculated with darker red, slightly-elevated spots closely resembling those of the cutaneous eruption; the latter appearance is most noticeable upon, and may be confined to, the soft palate.

Moderate enlargement of the glands behind the angle of the jaw is an ordinary feature, and the same condition of the cervical lymphatics may sometimes be observed.

There are anorexia, thirst, slight difficulty in deglutition, sometimes vomiting, and at first constipation, later diarrhœa.

Of nervous manifestations, irritability and drowsiness have been already mentioned. The latter symptom is often very marked, the child sleeping for the greater part of one or even two days before the rash appears, waking only to ask for drink or to have its urgent wants attended to, and then drowsing off again. There is no danger in this condition, unless it be associated with indications of cerebral disease or deepen into coma or alternate with decided delirium. Restlessness with mild delirium at night may take the place of drowsiness, and, in exceptional cases, convulsions occur.

Eruptive Stage.—The eruption usually appears in the evening of the fourth day. For a few hours immediately preceding its outbreak the nervous symptoms are increased, or, if absent before, are developed, and it is at this time that convulsions are most liable to take place. The rash shows itself first on the skin immediately behind, beneath, and in front of the ears; thence it spreads to the rest of the face, the neck, the trunk, and the limbs, completing its extension over the entire body in from twenty-four to forty-eight hours. It begins in the form of distinct maculæ, more or less deep crimson in color, rounded in shape, with irregular edges, and varying from half a line to three lines in diameter. These soon develop into slightly elevated papules with hard, flat summits, which feel firm to the touch and temporarily lose their color under pressure. Isolated and few in number in the beginning, the papules rapidly become more abundant, and show a tendency to arrange themselves into irregular clusters, the unaffected portions of the skin preserving the normal appearance. The intensity of the eruption varies greatly; sometimes the papules are

quite scattered and the few clusters are separated by large areas of healthy skin; at others they are so numerous and coalesce so closely that extended portions of the surface assume a dark-red tint. This coalescing is most frequently observed on the face, on the neck and back, and near the flexures of the joints. Occasionally, in very severe cases, minute vesicles form on the summits of the papules. After full development the rash shows little change for one or two days. It then begins to fade in the order of its appearance, assuming a lighter or yellowish-red color, and in a day or two later disappears, leaving only faint reddish stains which mottle the skin for several days longer. The subsidence of the rash is followed by desquamation, the epithelium falling in very fine bran-like scales. This process is most noticeable on the face, but even in this position may readily escape observation.

The rash may vary in other characters as well as in its intensity. Sometimes the papules on their first appearance are hard and prominent, resembling closely those of variola. Again, their crimson color may not entirely disappear on pressure—a condition due to great hyperæmia of the skin. Finally, the eruption may steadily grow darker until a deep-purple color is acquired; this is also due to intense hyperæmia with rupture of distended cutaneous capillaries. Such a rash does not disappear on pressure: it remains at its height much longer than the ordinary eruption, and is slow in fading.

Fig. 2.

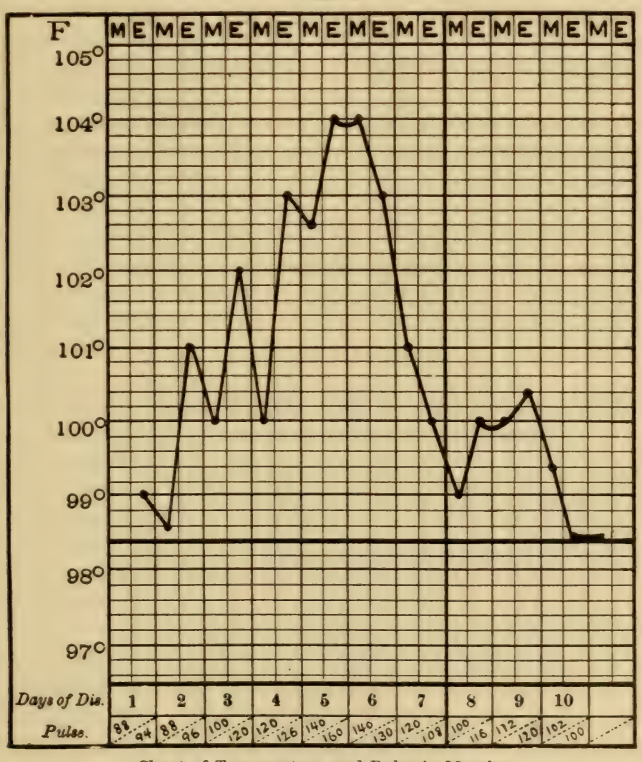


Chart of Temperature and Pulse in Measles.

The fever does not abate on the appearance of the eruption; on the contrary, it often attains a higher marking (103°–105° F. in the axilla) on the first and second day; after that, as the rash fades, it rapidly falls to the normal line.

The preceding chart (Fig. 2) presents a fair picture of the temperature curve of measles of average severity. The patient who furnished the record was a boy five years old, an inmate of the Children's Hospital, Philadelphia. Having been directly exposed to contagion, the symptoms of coryza were noticed on the day marked 1: the eruption appeared on the evening of that marked 4, and was at its height on 5 and 6. Afterward the eruption rapidly faded, and with it the temperature fell almost to the normal line on 8, though complete lysis was delayed for forty-eight hours by a trifling secondary laryngeal catarrh.

The pulse increases in frequency as the temperature rises, and follows its curve moderately closely. The maximum ratio is usually about 120 beats per minute, though it occasionally rises higher, as in the case just referred to.

During the acme of the eruption and pyrexia the catarrhal symptoms become more severe. The conjunctivæ are red, the eyelids are much swollen, photophobia is extreme, and there is a copious flow of irritating tears; the nasal passages are dry and encrusted, or there is a free discharge of acrid mucus, and crusts of dried blood may often be seen about the nostrils, for epistaxis is common. The upper lip is tumid and excoriated, the cheeks are swollen and deeply reddened, and the characteristic physiognomy, already mentioned as existing in the prodromal stage, is more strikingly marked. The tongue is usually moist, with a thick, yellowish-white central coating and red tip and edges; the soft palate, tonsils, and pharynx are red; and the throat feels sore. Thirst and anorexia continue; there may be some tumefaction and tenderness of the abdomen; moderate diarrhœa is the rule; and in some cases there are violent vomiting and purging. The respiratory movements are somewhat quickened: the voice is husky, the cough is paroxysmal, dry, hoarse, and troublesome, and attacks of spasmodic croup are apt to occur. Physical examination of the chest reveals the signs of catarrh of the larger bronchial tubes, and as a rule—especially in scrofulous children—of enlargement of the bronchial glands. The probability of a similar enlargement of the glands at the angles of the jaw and sides of the neck must also be remembered. The urine is scanty, dark yellow in color, with abundant urates, and, while the temperature remains elevated, may contain a trace of albumin. Prostration of the general strength is not decided in the majority of cases.

Stage of Decline.—So soon as the rash begins to fade—fourth day of eruption, eighth of disease—the other symptoms rapidly abate. The pulse loses its rapidity, though it is somewhat weaker than normal; the temperature steadily falls, often with considerable sweating; the coryzal symptoms subside; the voice becomes less hoarse; the cough grows looser and less frequent; and, if the child be old enough, nummular masses of muco-purulent matter are freely expectorated. The tongue cleans off; appetite returns; there is no longer thirst, irritability, or restlessness; the bowels return to their normal condition, and ordinary health is soon regained.

Modified Forms.—Measles without eruption and measles without catarrh have been described by different authorities. In regard to the first modification, it is difficult to doubt the records of certain isolated cases that have occurred during epidemics of the disease, though the author has never met with any examples. On the other hand, cases reported as "rubeola sine catarrho" must be classed under rubella rather than modified rubeola.

There is, however, a form of measles which is distinguished from its outset by typhoid symptoms, and is very fatal. Malignant, ataxic, or black measles, as this variety is called, may occur as an epidemic or sporadic affection, but it

is usually the former. There is great prostration; the patient is dull and stupid; the pulse is small, feeble, and frequent; the respiratory movements are difficult and rapid; the rectal temperature is high, often reaching 107° or 108° F., while the hands and feet feel cold; the tongue is dry, brown, and thickly coated; epistaxis is often obstinate, and hæmaturia may occur. The rash appears slowly, imperfectly, and irregularly, assumes a livid, purplish, or blackish hue, and may quickly retrocede; at the same time, the skin is thickly mottled with petechiæ. The attack progressing, the pulse becomes so rapid that it can scarcely be counted; there is muscular tremor with muttering delirium, and life terminates in coma or convulsions. After death ecchymoses may be found in the viscera.

Complications.—The conditions which disturb the regular course and threaten the ordinarily favorable result of measles are mainly furnished by an undue development of certain of the usual or unusual features—an exaggeration determined either by the nature of the special epidemic or by certain constitutional peculiarities of the individual affected. These complications may be described in the order of their frequency and importance.

Bronchial catarrh may spread from its ordinary position, the larger tubes, to those of smaller calibre, and become a grave complication. The extension is most common in infants under one year, and in them usually proves fatal through collapse of the lung—a condition readily produced at this early age. The indicative symptoms are dyspnœa and rapid breathing, lividity of the face and extremities, a haggard and anxious expression of the countenance, and the detection, on auscultation, of fine subcrepitant râles distributed throughout both lungs.

After the age of twelve months catarrhal pneumonia is more frequent than extended bronchitis. It is, in fact, the most common complication of the disease, and may occur at any time during its course. When it arises early, the eruption is often delayed, or, if already present, may retrocede, and there is considerable aggravation of the general symptoms. If later—at about the time of the disappearance of the rash, for example—the temperature, instead of falling, remains high, ranging in the neighborhood of 102° F.: in place of the usual general improvement, there are greater weakness and more manifest illness; the patient is listless and takes little interest in his toys or in what is going on about him; there is increased thirst and anorexia; the face is pinched and distressed-looking; the lips are livid, and the alæ nasi move to and fro with the breathing, which is labored and quickened. On physical examination of the chest the ordinary signs of broncho-pneumonia can be detected. This complication varies greatly in degree of severity. It often runs a prolonged, subacute course, and may terminate in complete recovery, in death, or, becoming chronic, may merge into one of the varieties of pulmonary phthisis.

Intestinal catarrh, which is usually productive of nothing more than a trifling, readily-controlled diarrhœa, may be aggravated into an entero-colitis, or even an ulcerative inflammation of the mucous membrane of the colon. These complications are excited by improper food, by injudicious use of purgative medicines, and by careless exposure to cold and dampness. They sometimes appear during the initial stage, but are usually developed later in the disease. The symptoms are tumidity and tenderness of the abdomen, colic, tenesmus, and more or less frequent purgation, the evacuations being green in color and containing glairy or bloody mucus. The regular course of the disease is little affected, though in nervous, sensitive children the intestinal lesions may maintain a temperature of 104° or 105° F. for several days after the subsidence of the rash. In such cases convalescence is prolonged, though

the ultimate outlook is favorable unless catarrhal pneumonia coexists; then the danger inherent to the latter condition is greatly increased.

Laryngitis often complicates measles. It is most likely to occur during the decline of the eruption. Ordinarily the spasmodic form—false croup—is assumed, with symptoms that are alarming to the uninitiated, but really devoid of actual danger and without effect upon the regular course of the disease. Sometimes, on the contrary, a pseudo-membranous exudation forms in the larynx, and the case at once becomes extremely grave. The symptoms are the same as in idiopathic cases. Thickening, softening, and ulceration of the mucous membrane occasionally occur, and Rilliet and Barthez record a case in which suppuration about the larynx followed an attack of measles.

Convulsions happening during the eruptive stage are of grave import; preceding it, they are seldom serious.

Epistaxis, when it becomes profuse and exhausting, always tends to postpone the restoration to health, and may determine death in weak subjects or when the disorder is severe and ataxic in type.

Ophthalmia and otitis are infrequent complications, and are almost entirely limited to patients having tuberculous tendencies. Both yield sluggishly to treatment, and otitis may prove fatal by an extension of the inflammatory process to the membranes of the brain.

Paralysis should be mentioned as a rare accident that may be associated with measles. Drs. Barlow and Ormerod have recorded cases in point.

Sequelæ.—Many of the conditions referred to as complications may also occur as sequels of the disease. Thus catarrhal pneumonia, laryngitis, and bronchitis in chronic form, and chronic gastro-intestinal catarrh are frequent results. Enlargement of the bronchial glands is another common sequence, and acute tuberculosis so often follows that the physician must suspect its development whenever a patient remains feeble and feverish after an attack of measles. In children having a tuberculous diathesis the disease is very prone to light up any or all of the troubles which are characteristic of their constitutional taint. Other less common sequelæ are "marasmus," or a condition of general wasting and debility; diseases of the eyes and ears; ulcerative stomatitis, with necrosis of the jaw; gangrene of the cheek and vulva; necrosis of the nasal cartilages; and, rarest of all, renal disease.

Whooping-cough is generally supposed to bear an intimate relation to measles. Epidemics of the two diseases undoubtedly often follow close upon each other without any uniformity of precedence. What the actual connection may be is uncertain, but it is probable that the presence of one exanthem merely lessens the resistance which a healthy body manifests to the infective power of the other.

Diagnosis.—The distinguishing features of rubeola are the long prodromal stage with its marked catarrhal symptoms; the course of the fever-curve, especially the continuance of high temperature for two days after the appearance of the eruption; and the peculiarities of the rash. It should be remembered, however, that the rash, though quite characteristic in typical cases, is more apt to be misleading, through its variations, than any of the other pathognomonic signs; and it may be said of measles, as indeed of all other exanthemata, that a diagnosis must never be based exclusively upon the eruption.

In the initial stage it is often difficult to differentiate between measles and an ordinary acute catarrh—a "severe cold." The coryzal symptoms are identical: hoarseness and cough are present in both, and both are attended by fever. If such symptoms are developed at a time when measles is epidemic, the probabilities are strongly in favor of an attack of the disease. On the

other hand, if the history of exposure to contagion is uncertain, it is best to withhold a decided opinion and wait for the appearance of the rash, which, it is well to recollect, shows upon the soft palate from twenty-four to forty-eight hours before it can be detected upon the skin. It may be stated here that this element of uncertainty in the early diagnosis is much to blame for the ready and wide extension of the disease; for, while contagion is freely given off by patients in the catarrhal stage, isolation is rarely practised until all doubt as to the nature of the attack is cleared up by the eruption.

Sore throat, which is sometimes present, combined with fever, may suggest scarlatina, but the latter disease has a sudden onset, with vomiting, rapid and extreme elevation of temperature, and very frequent pulse, and without catarrhal symptoms; further, the characteristic eruption appears not later than twenty-four hours from the commencement of the attack.

In the eruptive stage, when the color and grouping of the papules are typical, and the fever, coryza and cough marked, there is little room for error.

When the rash appears in hard, isolated papules, variola may be suspected, a mistake not uncommonly made. In small-pox, however, the pre-eruptive stage is characterized by obstinate vomiting and severe pain in the back. When the eruption appears, the temperature abruptly falls and the active symptoms abate; the papules themselves are harder than ever noticed in measles, feeling like pellets of shot under the skin, and by the second day those first appearing on the face are changed into vesicles.

There is more difficulty in distinguishing the rubeolous eruption from the rash of rubella than from that of any other of the exanthemata. The points of distinction are the short, often featureless, prodromal stage of rubella, the comparative absence of catarrhal symptoms, and the fact that the papules are smaller and lighter in color, appear almost simultaneously on the face, the wrists, and the ankles, and thence extend over the body, showing no tendency to irregular grouping.

Various skin eruptions, notably the early stages of acute and general eczema and syphilitic roseola, resemble the rash of measles, but the differences in clinical history and the entire absence of general symptoms render the distinction easy.

Prognosis.—Generally speaking, the percentage of fatality in rubeola is small. Nevertheless, in individual cases the prognosis depends upon the type of the epidemic, the age and previous condition of health of the patient, the nature of the hygienic surroundings, and the character aud severity of the complications.

An attack, of whatever severity short of malignancy, occurring in a previously healthy child over the age of two years, who is surrounded by the usual comforts of life and treated with ordinary skill, should almost invariably terminate in recovery; and in such cases even the onset of so serious a complication as catarrhal pneumonia is rarely fatal. Quite the reverse is true when the disease attacks children who are constitutionally feeble or debilitated by some antecedent acute disease, who are suffering from rickets or suppurative bone disease, who have chronic pulmonary lesions, who are subjects of the tuberculous diathesis, and who live in crowded and filthy houses or unhealthy localities. These patients, when they survive the force of the disease itself, are often carried away by one of the complications or sequelæ, to the development of which they are very prone.

In children under two years of age measles is more serious, and the younger the infant the greater is the danger of an unfavorable termination. Here death is due to the readiness with which bronchial catarrh extends to the finer tubes,

producing catarrhal pneumonia or pulmonary collapse—a tendency inherent to every catarrh in the very young, but most marked in that attending measles, and very apt to be exhibited in weakly or rachitic infants.

The gravity of the different complications and the fatality of epidemics of malignant type have already been referred to. In ordinary epidemics the prognosis becomes unfavorable under the following conditions: When the prodromal stage is more prolonged than usual and attended by violent symptoms of any kind, as great jactitation, irritability, dyspnœa, stupor, and coma or convulsions; when the eruption is irregular in development or course; when the pyrexia continues after the subsidence of the rash; when in the later stages of the disease the face remains deeply flushed or grows pale; when cough, dyspnœa, or diarrhœa persist, and when the child is left weak, languid, dispirited, or irritable.

Dr. Ellis places the mortality of measles at 1 in 15 cases. My own experience has been much more fortunate. In private practice all of my cases have recovered save one, and that, an infant of nine months, died of meningitis directly due to the active lighting up, by the measles, of a long-standing disease of the middle ear. Even in my hospital wards the mortality has been less than that given by the author quoted, and the deaths, while occasionally due to the force of the poison on enfeebled bodies, have mainly occurred in patients previously affected with spinal caries or suppurating joints or having badly deformed rachitic chests.

Before leaving this division of the subject some attention should be given to the question of the liability of the *return* of measles. The fact is, that, next to typhoid fever, measles is the most liable of all the exanthemata to return. A number of cases are on record in which patients have had a second attack after a short interval, and sometimes so soon after the first as to constitute a true relapse, both attacks running their course within a period of four or five weeks.

Treatment.—Attention must be directed first to the hygienic management of the disease, as this is of vast importance in all cases, and in those of ordinary severity suffices, with a very little aid from simple drugs, to ensure a favorable ending.

As early as the nature of the attack can be decided upon the patient must be put to bed, and confined there until not only the rash itself, but all traces of the remaining yellowish-red stains, have disappeared—about the eighth or tenth day of the disease. Young infants, with whom it is difficult to enforce complete rest in bed, must, when taken up, be held upon the nurse's lap and be properly protected by some light wrap. If it be possible to have two cots, one for day and the other for night use, the patient's comfort is greatly increased. Care must be taken to provide only sufficient bed-covering to maintain warmth; the mattress should be of hair, and, when only one bed is at command, the sheets ought to be changed at least once each day, though accidental soiling may render more frequent renewal necessary. A large, airy, and, if possible, isolated chamber is to be selected for the sick-room, and an open fireplace for wood or coal is the best method of heating, at the same time securing free ventilation without draughts. When heat is supplied from a furnace, change of air must be effected by a window or door, the patient being protected from chilling currents by a carefully placed screen. The proper temperature is 65° to 68° F. During the continuance of photophobia and conjunctival irritation the room must be moderately darkened, and it is always well to see that the bed is so placed that the patient's face will not be turned directly toward a window. All superfluous hangings and furniture

should be dispensed with, though it is unnecessary to strip the apartment so completely as in case of scarlet fever.

After the child is well enough to leave his bed he should be kept in the sick-room for three or four days; then, so far as his own safety is concerned, he may be allowed the range of the house, but not permitted to go out doors for a week longer, and then only in favorable weather. If, however, there are other susceptible subjects in the house, and the question is one of isolation, he must not quit his chamber until the end of the third week from the beginning of the attack.

The diet requires careful regulation. Nursing infants must be fed, during the febrile stage of the disease, at somewhat shorter intervals than in health, but if, on account of increased thirst, they suck very greedily, the time of lying at the breast must be curtailed, the object being to secure sufficient nourishment without at any time overloading the alimentary canal and overworking the digestive powers, which are enfeebled by the catarrhal condition of the mucous membrane. With bottle-fed babies it is even more essential to carefully regulate the administration and preparation of the artificial food. For example, a child of nine months, who in health would be fed five times daily and take in all about forty fluidounces of appropriately strong food, must during measles be placed nearly on the plane of a child six months old, the feedings being increased to six or eight a day, the total quantity reduced to thirty or thirty-four fluidounces, and the strength proportionally lessened. For the purpose of dilution lime-water or barley-water may be employed with advantage, on account of its power of preventing rapid coagulation and the formation of large, tough curds in the stomach.

Should ordinary milk mixtures disagree, it is well to resort to Pasteurization or partial predigestion, and if it be impossible for the infant to retain any form of milk food, as is sometimes the case, raw beef juice in doses of two teaspoonfuls every two hours, or veal broth and barley-water may be resorted to as temporary substitutes.

Patients who are old enough to take a mixed diet when well should at once be placed upon liquid food.

To relieve thirst, pure water, carbonic-acid water, and Vichy are preferable to any of the old-fashioned sweetened or acidulated drinks. They are to be given cool (not iced), and in moderate quantities at short intervals. In administering drink a good plan is to use a small glass—holding a fluidounce, for example; to drain this gives the child more satisfaction than the same draught from a larger vessel which he is not allowed to empty, and there is much less danger of an excessive quantity being taken.

With the decline of the temperature and the abatement of symptoms denoting gastro-intestinal disturbance, additions may gradually be made to the diet until the full feeding of health is resumed.

Due attention must be paid to keeping the patient's person clean. To this end the face, hands, portions of the body liable to become soiled, and even the whole surface, should be sponged with tepid water every morning, each part being washed and dried separately, so as to avoid exposure and chilling.

When the patient is well enough to go into the open air, it is essential to see that he is properly dressed with warm woollen under-clothing; morning spongings with salt water may also be ordered now, and complete restoration to health will be greatly hastened by a change of air. So the atmosphere be dry and bracing, it makes little difference, in ordinary cases, whether the resort selected be at the sea-coast or inland, though the former is to be preferred when

the disease leaves the subject with marked glandular enlargements or develops other manifestations of the tuberculous diathesis.

The medicinal treatment of ordinary cases of measles is very simple. Early in the attack, while the temperature is elevated and the cough hoarse, citrate of potassium is useful as a febrifuge and relaxing expectorant. To a child six years old from one to two fluidrachms of liquor potassii citratis should be given every two hours, and to this may be added 20 drops of paregoric and 5 or 10 drops of syrup of ipecacuanha if the cough becomes very troublesome and croupy—a tendency often exhibited during the first two or three nights of the attack. Later, as the cough grows loose, a stimulating expectorant should be substituted. The best of this class of drugs is chloride of ammonium, which must be given in solution and in doses of 1 to 2 grains every second hour. As convalescence approaches the expectorant may be gradually discontinued, and 1 grain of quinine may be given three times daily, either in solution or in chocolate tablets; sometimes, too, there is sufficient debility to warrant the administration of moderate doses of whiskey. Finally, a course of iron or of cod-liver oil—in tuberculous cases—is often necessary.

While pursuing these general measures the eyes need careful attention. Four times daily the lids should be washed with water as hot as can be borne, and afterward a few drops of a solution of borax (gr. x to f℥j) gently applied to the conjunctivæ. In case of great photophobia and conjunctival irritation a weak solution of cocaine (gr. j to f℥ss) may be dropped into the eye twice daily. It is well also to spray the nares and pharynx at frequent intervals with Dobell's solution or Listerine diluted with water (1 part to 6), or, if the patient be old enough, the throat may be gargled every three hours with one teaspoonful of chlorate of potassium dissolved in 4 fluidounces each of claret and water. Mild counter-irritation of the skin of the throat is often of service in relieving pain and hoarseness; for this purpose a combination of turpentine and olive oil (1 part to 2 or 3) may be employed several times in the twenty-four hours.

Malignant measles demands a stimulant and tonic treatment. Whiskey or brandy in properly proportioned quantities must be added to the milk, or brandy-and-egg mixture may be employed, and raw beef juice and concentrated meat broth must form an element in the diet. Of drugs, quinine, carbonate of ammonium, and digitalis are called for, and must be used in sufficient doses to meet the urgency of the indications. In this form mustard baths and hot packs are of great service. For the mustard bath, which is more suitable for children under three years of age, the water should be at a temperature of 100°, and contain about one tablespoonful of mustard to the gallon; the patient is immersed up to the neck for three minutes, then quickly dried and placed in bed between blankets or wrapped in a blanket and dried later. The bath may be repeated in two hours if necessary. In hot packing the child is placed between blankets, and then a blanket wrung out as dry as possible, after being wet with hot water or mustard and water (two teaspoonfuls to the gallon), is quickly wrapped about the body, care being taken lest it be too hot; it may be renewed in half an hour.

At times one or more of the symptoms of the disease may be so modified or exaggerated as to require special treatment.

Headache, when violent, is usually attended by constipation, and can be relieved by unloading the bowels and by putting the feet in hot mustard-water (one tablespoonful to the bath) or applying a mustard plaster (1 part to 4 or 6 of flour) to the nape of the neck. For the purpose of evacuating the bowels enemata or glycerin suppositories should first be tried, and if these

fail, a mild laxative, as calomel in broken doses or milk of magnesia with aromatic syrup of rhubarb, may be administered. Active purgatives should never be employed, on account of the decided diarrhœal tendency of the disease. Should these measures fail to relieve the headache, resort must be had to bromide of potassium or elixir of the valerianate of ammonium.

Moderate looseness of the bowels need not be interfered with, but if the purging be sufficiently violent and continuous to threaten the strength of the patient, a combination of rhubarb, bismuth, and chalk mixture may be prescribed, or, if the evacuations be very watery, it may be necessary to use a more powerful astringent, as oxide of zinc in doses of gr. $\frac{1}{4}$–$\frac{1}{2}$ every three or four hours.

Distressing vomiting is best treated by causing the patient to drink tepid water, and, when the stomach has been relieved of altered food and irritating secretions, applying weak mustard plasters to the epigastrium. In this condition, however, it is most important to pay careful attention to the feeding.

When the eruption is delayed, appears irregularly, or retrocedes, it must be remembered that the condition depends upon some complication—bronchopneumonia, for example—and that the true mode of relief is to relieve the internal inflammation which is the cause of the difficulty: hot mustard foot-baths or full baths, hot packs, mustard sinapisms, and stimulants are required. Liquor ammonii acetatis is a useful preparation in these cases; it may be given in doses of one to two teaspoonfuls every two hours. When the rash itches or burns, frequent applications of fresh lard or vaseline will afford relief.

At the acme of the eruption the temperature often runs up to 104° or 105° F. for a few hours, without corresponding severity of the other symptoms. No interference is necessary for a temporary elevation of this sort, but for a persistently high temperature of twelve hours or more some antipyretic must be given or cooling baths resorted to. Antipyretics are still on trial, but the safest is phenacetin. This may be administered in an initial dose of 1 grain for any age between two and six years. If the temperature falls afterward, wait and observe the extent of the depression; if not, repeat the dose after the lapse of an hour; should this fail, gradually increase the amount to 2 or 3 grains. The first dose may be given when the temperature ranges above 103°, and the drug may be repeated as often as necessary to keep it below this point, the cardiac condition being carefully watched in the mean time.

When baths are employed to reduce the pyrexia, water at a temperature of 95° to 98° F. should first be used; if this fail, tepid or cold spongings may next be resorted to, and as a final resort the tepid or cooled bath may be tried. In giving the latter the child should be undressed as quickly as possible, and then immersed in a bath of 90° F.; cold water is now rapidly added until the temperature of the bath is reduced to 80°. After a sufficient intermission—usually five or six minutes—the body is quickly dried with a soft towel and the patient put back to bed between sheets. The effect of the bath is sometimes very powerful, and the child remains livid-looking and collapsed for some time. In such case small doses of brandy must be given in warm milk at short intervals and artificial heat applied to the feet.

It is stated by some authorities that antipyretics ought to be employed whenever the temperature reaches 102° F. Such a rule is dangerous. There are many instances in which, with a temperature of 102°, the child is very ill, and this degree of fever may be judged to be more than usually detrimental. For these a bath, either tepid or cold, cold sponging, or phenacetin, may be

recommended, but for one such case there are many others that run a perfectly favorable course with a temperature even higher than this, and in which it is difficult to see what benefit could have accrued from antipyretics. Each case must be treated upon its own merits.

When in doubt as to the propriety of using antipyretic drugs or baths, it is well to try the effect of moderately full doses of sulphate of quinine. It has been my own experience that this agent given by the mouth, or, better still, by the rectum, in suppositories of two to four grains every three or four hours, frequently reduces temperature, and, should there be much associated restlessness, produces sleep.

The treatment of convulsions, broncho-pneumonia, and other disorders which may be associated with or follow after measles does not differ from that employed when these affections occur idiopathically, and therefore requires no especial consideration here.

Quarantine.—The rubeolous patient should keep his bed for eight or ten days and his room for three weeks; then, if he be quite well in every respect, there is little danger in his mixing with his playmates. When one member of a household is attacked, it is necessary for the other children of the family who have not had the disease to stop going to school or associating with other children, as it is probable that they also have contracted the malady, and, as it is infectious in its early stages, they may readily be the means of giving it to others. For the same reason it is unwise to send them away from home; at the same time they must not come in contact with the case already developed.

The convalescent should have a warm bath and fresh clothing before mingling with his associates. Scalding of the bed- and body-clothing and thorough airing and cleaning of the sick-room are all that is necessary in ordinary cases, though in malignant epidemics disinfection of the bedding and thorough fumigation of the chamber with sulphur should be insisted upon.

SCARLET FEVER.

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Scarlet fever, or scarlatina, is a self-limited, contagious, microbic disease, characterized by fever, angina, and a typical eruption, and followed by desquamation and recovery in about three weeks if the disease be uncomplicated.

The health reports of all of our large cities show that scarlet fever is an endemic disease of childhood, never being entirely stamped out, and affecting now only a trivial percentage of the population, and then increasing into epidemics of frightful mortality, often from causes as yet unknown to modern science.

According to Busey, it is the most widely disseminated of the exanthemata of childhood, and, perhaps rightly, the most dreaded of all the diseases of children, whose susceptibility varies not a little with their age. Infants under six months, as a rule, escape; 64 per cent. of all cases occur in children under six years of age (Murchison), after which susceptibility diminishes, though liable to as yet inexplicable variations, for children and nurses who have escaped half a dozen epidemics may succumb to the seventh after exposure apparently in no wise different from that which preceded it.

One attack, as a rule, protects from a second, though well-attested returns are on record. The majority of those cases popularly reported as second attacks are usually due to errors in diagnosis. But it must also be remembered that frequent abortive attacks of sore throat are well known to occur in nurses or physicians attending cases of this disease.

Scarlet fever may be complicated with other of the exanthemata, especially varicella. Cases of coincident scarlatina, variola, and measles are reported by Vogel.

While the disease is not so infectious as measles, as shown by the fact that 42 per cent. of Budert's unprotected children escaped infection during an epidemic in the isolated German village of Neundorf, it should be remembered that the contagiousness of scarlet fever varies greatly with the epidemic.

Brush's statement that the colored race possesses an immunity from this disease is erroneous, for the writer has seen scarlet—or rather royal purple—fever in a coal-black pickaninny, and in Chicago, at least, colored children enjoy like privileges in this respect with those of lighter skin.

History.—It is more than probable that scarlet fever must have existed as far back as there have been masses of people crowded together in great cities; but there are no earlier accounts of the disease than those of the seventeenth century (1610–18), when epidemics occurring in Spain and Italy were described by Mercatus, Heredia, and Syambatus (Bohn). About the year 1625 both sporadic and epidemic cases were met with in Breslau and described by a Dr. Doring, who is probably entitled to the honor of being the first German author to write on this subject. He was closely followed by Sennert's description of

the disease at Wittenberg, later followed by like outbreaks at Brieg (1642), Schweinfurt (1652), and in Poland (1664).

Up to the time of Sydenham scarlet fever was supposed to be a variety of measles, being known by such fanciful terms as "ingrassius, rosalia, rubeolas, morbilli ignei," etc. During the years 1670–75, Sydenham had ample opportunity to study the epidemics raging in the city of London, and differentiated the disease from measles. The origin of the name is yet uncertain (Bohn).

To Fothergill (1750) justly belongs the credit of establishing the contagiousness of scarlatina, and the facts upon which depend all modern theories of its prophylaxis. But many writers believe that the disease has steadily increased in virulence, until to-day it is the most prevalent and dangerous of all the diseases of childhood.

Scarlet fever is supposed to have been brought to North America in 1735, spreading slowly from the coast inland, and so infrequently met with that Dr. Rush, as late as the beginning of the present century, wrote: "No physician would be likely to see it more than once in his lifetime." At first it was regarded as rather a trivial affection, but malignant epidemics swept through Kentucky and Ohio when the country was almost an unbroken forest. Then came a period of slight malignity, so that Professor Chapman of the University of Pennsylvania so late as 1833–36 positively denied the contagiousness of this disease.

Etiology.—He would be a purblind physician who, in these latter days, would attempt to deny the microbic origin of scarlet fever, but it must as frankly be admitted that our knowledge concerning its exact etiology is as yet indefinite and conflicting. Klebs figures the peccant microbe and names it Monas scarlatinosum. Ecklund of Stockholm minutely describes another, which he is certain is the cause of scarlet fever, and proposes the name Plox scindens, a fuller description of which may be found under the heading of Pathology. Edington of Edinburgh later isolated from the blood and epidermic scales of scarlet-fever patients another microbe, which he and Dr. Shakespeare of Philadelphia unite in declaring to be the specific cause.

But, while it is disheartening that as yet we know so little accurately concerning the bacteriology of scarlatina, there is much that is well known and proven beyond dispute in regard to the spread of the disease and the nature of its contagion. First of all, it can be insisted upon that its *contagium vivum* is easily portable, tenacious in its power to do evil for years, and with great probability originating in some of the lower animals. The horse, the dog, and the cow all have had their claims advanced as first owners of the scarlatinal microbe, and during the Hendon epidemic some years since it seemed as if the question had been decided in favor of the cow. Later and more accurate investigations, however, seemed to show that the disease carried from the diseased teats of the infected cows was scarlatinal only in the form of the rash communicated to human beings.

There is also considerable dispute as to which of the secretions may carry the scarlatinal virus. Some writers insist that the patient is a source of infection from the initial sore throat until the last branny scales have dropped away from between the fingers and toes; others, that infection may be carried so long as there is a specific otorrhœa. Undoubtedly, the micro-organism usually enters the system by inhalation, but there seems to be good reason for believing that it may be taken in with food (Smith), or carried from person to person by inoculation of scarlatinal blood or blood-serum. It is, however, generally conceded that a scarlet-fever patient is most dangerous during the stage of desquamation, and that the branny scales of this period

PLATE VI



Original impure cultures from skin.
× 1000.



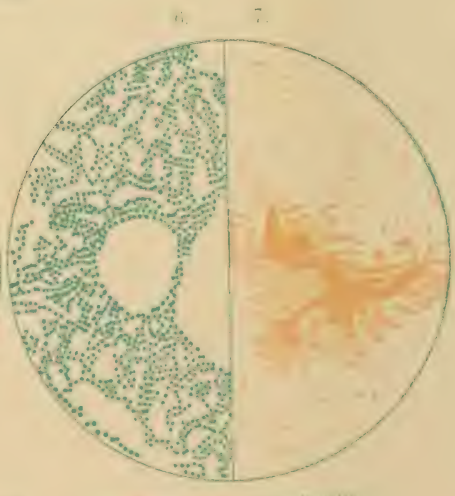
Original impure cultures from skin.
× 1000.



Original impure cultures from skin.
× 1000.



Bacillus Fulvus.
× 1000.



Streptococcus Ruber Invasus
Streptococcus Sanguinis.
× 1000.

Plates illustrating the cultivation of the bacillus scarlatinæ according

PLATE VII











Fig. 1. Bacillus Typhi Murium, Loeffler, 1892.

are the most frequent carriers of the contagion, though others claim like dangerous properties for mucus, urine, and the fæces. It is certainly true that the contagion of scarlet fever may be carried by almost every conceivable article of apparel or material used about the sick, for next to the variolous microbe the scarlet-fever contagion preserves its vitality for a longer time than any other of the exanthematous poisons. Dr. Holland relates an extraordinary case where the virus survived two generations, being packed away in clothing in a chest for thirty-five years, at the end of which time it communicated the disease to a grandchild for whom some of his grandfather's clothing was made over. To the writer's knowledge, the disease remained hidden in a fur cloak packed away for more than a year, and then communicated the disease to an entire logging community isolated for the winter in the wilds of Northern Michigan. Hence the exact origin of any given case of scarlet fever is often most difficult to accurately settle, especially when we remember the possibility of the disease being carried by books, letters, or toys from some previous case.

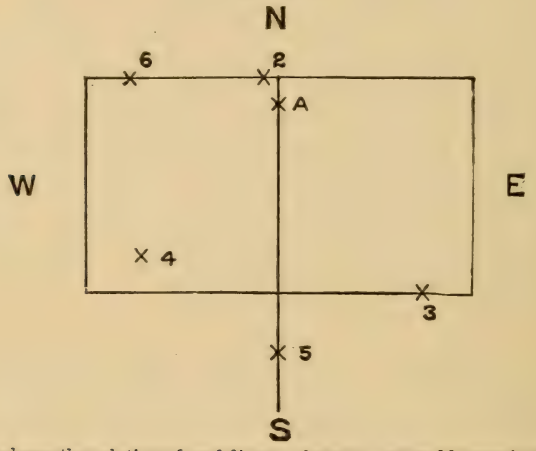
Next to library-books, letters, clothing, and toys, milk seems frequently to be the medium of contagion. In one instance milk is known to have carried scarlatina to one-half of the families to which it had been delivered, although it had not been touched by the milkman or other members of the infected family (Taylor); and in another the disease was carried to all the families served save one, which consisted only of elderly people (Bell). Powers and Klein still teach that the disease originates from the sore teats of infected cattle suffering from bovine fever, but, after much heated discussion on the subject, it appears that the disease thus communicated is modified cow-pox rather than true scarlet fever (Hendon epidemic, 1885). The persistence of the scarlatinal virus in clothing and apartments after ordinary methods of disinfection is sometimes amazing. J. Lewis Smith relates the case of a Sunday-school librarian who contracted the disease from books returned from an infected tenement-house. One month after his recovery the room in which he had been sick and his clothing were disinfected with burning sulphur, and yet he succeeded in carrying the disease personally to his sisters after a journey of three hundred miles to an isolated country town, to which they had been quarantined. These sisters infected the room in which they were confined, so that children visiting it, after its disinfection, in turn contracted the disease. The writer knows of a building in the city of Chicago in which, in three successive years, the children of the families moving into the house contracted scarlet fever in spite of yearly domestic disinfections.

Mode of Transmission.—Although it is usually believed that the scarlet-fever poison is not volatile and cannot be carried by the atmosphere solely, the case sketched in the description of Fig. 1, contributed by an intelligent medical student, apparently contradicts previous statements on this subject.

Bacteriology.—Illingworth still claims, I believe, that the germs of scarlet fever are set free during the fermentation of animal and vegetable refuse. The inhalation of these causes them to lodge upon the mucous membrane of the throat, where they propagate, and, by the reabsorption of their products, produce the other lesions of scarlet fever. Almost all other authorities believe that there is a specific scarlet-fever microbe, which requires a previous human being for its host. Repeated efforts have been made to isolate this micro-organism. As early as 1882, Ecklund of Stockholm thought he had discovered it in the form of colorless discoid corpuscles, about one-tenth the size of the red corpuscle, and found in immense numbers in the urine of scarlatinal patients. These he named *Plox scindens*. He states that he had found them

in vast numbers in the soil and ground-water of the island of Skeppsholm during an epidemic of scarlet fever there. Their presence seems to be well proven, but their relation to scarlet fever is by no means as definite. More

FIG. 1.



"The above rude map shows the relation of, and distance between, several houses in the township of Claremont, Minn., one inch representing a mile. In the house A lived Wm. Connell. During February of 1879 one of his children contracted scarlet fever through a letter that came from relatives in Toronto, Canada. About three days later a second child came down with the disease and died on the ninth day. The wind had been blowing from the north-east, and about this time my younger brother came down with the disease in house No. 4. Young James Connell was buried on the day after his death; and on that day the wind changed into the north-west, where it continued for some time. The bedding and clothes of the Connells were hung on the clothes-line to air, and in about one week from that time the children in house No. 3 were taken with the disease. In house No. 2, thirty rods north, there were five children, in house No. 6 there were four children, and in house No. 5, two children. All of these escaped the disease. There was absolutely no communication between the houses on account of the cold weather and fear of the disease. Two years later there came an epidemic of the disease in that vicinity of a severe type, and all the children in the neighborhood had the disease, except those that had had it two years previously."

hopeful are the results of Dr. Edington of Edinburgh, who began in 1886 to make investigations of the blood and epidermis in human scarlet fever. He succeeded in isolating a diplococcus scarlatinæ sanguinis and a bacillus scarlatinæ. Inoculation of the bacilli produced in rabbits erythema and desquamation; in calves, fever and a rash, followed by desquamation. Dr. Edington says "the bacilli measure 1.2 to 1.4 micro-millimetres in length and 0.4 micro-millimetre in width, and are found in the blood during the first two days only, in the desquamating epidermis only after the twenty-first day, and in the eighteen intermediate days they cannot be demonstrated in any of the tissues." His results have been confirmed by Dr. E. O. Shakespeare, who proposes the provisional name of *bacillus scarlatinæ* for this micro-organism, and reports that, "sown on gelatin-plates, it forms little points of liquefaction after several days. Sown in test-tubes of Koch's jelly, it rapidly liquefies it, but with no distinct growth-formation. The fluid thus formed is crowded with the motile bacilli, but a pellicle is not formed until the liquefaction is well advanced." This occurred in every case but one of the tubes made from the desquamation if taken after the termination of the third week, but never before this. It also occurred in every tube made from scarlatinal blood if taken before the third day of the fever. Inoculation upon rabbits produced erythema, best marked in the old, and in from two to five days a fine desquamation, which lasted for a week to ten days. Temperature, 103°–106° F. Similar results were obtained from guinea-pigs, except that the desquamation was more copious and the hair fell out if pulled upon.

"A calf was then inoculated, and at the same time given some of the

culture in milk. The calf was in good health at the time, and had a temperature of 99.5° F. Six hours from the inoculation the calf developed great sickness, and the temperature taken in the axilla registered 103° F. [This was at 10 P. M.] The calf was then left for the night, but in the morning was found dead. Small portions of the spleen and kidneys were taken from the animal, placed in Koch's jelly, and allowed to incubate, and developed the characteristic bacillus previously described. A second calf was inoculated, when only one day old, with the bacillus, care being taken that the inoculation was made with the absolutely pure material. Previous to the injection the calf's blood was examined, and found to contain no organisms. The inoculation was made in this case with a very carefully sterilized hypodermic syringe. At 6.30 P. M. this was performed, the temperature per rectum then being 99.6° F. At 10 P. M. the animal took milk freely, and the temperature remained practically the same. Next morning, temperature 104°; sickness, slight diarrhœa, and great prostration, and the throat inflamed. In the afternoon the skin of the thorax, upper abdomen, and inner side of the foreleg presented a general redness, increasing toward evening (T. 102.8°). The next morning the animal was better, but rash still vivid, throat and posterior part of the tongue inflamed (T. 102°). From this time the beast steadily improved, and on the sixth day desquamation set in."

The same bacillus, according to Dr. Shakespeare's report, may be obtained from the blood of a scarlet-fever patient during the first two or three days of the disease, and from the desquamating scales on the twenty-first day in an ordinary case; if malignant, they may be obtained earlier. These bacilli rapidly increase in warm milk, which they may thus infect.

"The rapidity of the growth of this organism—which is such if one inoculate a flask of broth the diameter of which is two inches and a half, and if it be incubated, the pellicle will develop and cover it entirely over in the course of four hours—suggests an explanation of the short incubation of scarlet fever when furnished a proper pabulum."

Such, it seems to the writer, is a fair statement of our present knowledge on the subject, to be confirmed or reversed by later investigations.

Pathology.—Aside from its bacteriology, still in dispute, there cannot be said to be any pathological changes pathognomonic of scarlet fever. Autopsies made upon those dying in the earlier days of the disease show only the local lesion of the throat and engorgement of various internal organs, especially the intestines and brain. Deaths occurring later are generally due to septicæmia or nephritis. The former are apt to show secondary pneumonia and metastatic abscesses, and the blood coagulates poorly and is prone to form clots in the right ventricle. The characteristic changes of pleurisy, pericarditis, endocarditis, purulent meningitis, empyema, or pulmonary gangrene may be found in these cases.

The kidney lesions are those of an acute exudative (Delafield) or glomerulonephritis (Welsh), the latter being the true post-scarlatinal nephritis. In such cases "the liquor sanguinis and the red and white blood-cells escape from the renal vessels into the tubules. Swelling or necrosis of the renal epithelium, with changes in the glomeruli, occurs."

Macroscopically, the kidneys are large and flabby, and the cortex is thick and pale, with injected capillaries. The tubal epithelium is swollen and opaque. Hyaline cylinders identical with the casts are found in the convoluted tubes, and more abundantly in the straight tubes, along with irregular masses formed from the exuded blood-plasma. In the tubes are also red and white blood-cells. The glomeruli exhibit important changes. They become larger or more

opaque, due to the swelling and growth of the cells on and in the capillaries, "for the glomerular capillaries in their normal state are covered on their outside by nucleated cells, and flat cells line their inner surfaces in places, not continuously. On account of these cellular changes, the individual capillaries in the glomerulus become indistinct, but the main divisions of the tufts are visible. In very severe cases the growth of the cells on the tufts is so considerable that they form large masses of cells between the glomerulus and its capsule. The walls of the arteries in the kidneys may be thickened by a swelling of their muscular coats, and the Malpighian bodies may stand out like grains of sand."

This connective-tissue growth Delafield considers characteristic, "involving not the whole of the kidney, but symmetrical strips or wedges in the cortex, which follow the line of the arteries. These wedges are small or large, few or numerous, regular or irregular, in different kidneys, but in every wedge we find the same general characters: one or more arteries, of which the walls are thickened; glomeruli belonging to these arteries, with a large growth of capsule; cells compressing the tufts; a growth of new connective tissue in the stroma around and parallel to the arteries. Between the wedges we find at first only the changes of exudative nephritis; later, a diffuse growth of connective tissue. If the nephritis is of acute type and longer duration, the tissue is denser and has more basement substance. Where the growth of the new tissue is abundant the tubes become small and atrophied. The exudation from the blood-vessels is very considerable, so that the urine contains large quantities of albumin, many casts, and red and white blood-cells" (Delafield and Prudden). The irregular distribution of these kidney lesions, according to Bartel, explains the contradictory results often obtained by successive examinations of the urine. There may be parts of the kidney which entirely retain their functions, and from these normal urine may be secreted. But that a scarlatinal dropsy may exist from beginning to end without the presence, at any time, in the urine of either blood, albumin, or casts, is as improbable as that dropsy may occur without nephritis (Bohn).

Incubation.—Formerly a week or ten days was given as the usual length of the stage of incubation; later writers, however, fix it at two to five days, and it may, in malignant cases, last not more than twenty-four hours. But it is often difficult to say exactly when the stage of incubation ends and that of the initial sore throat begins. Murchison's table (Smith, p. 275) shows that in the great majority of the cases reported by him the stage of incubation was within five days, and the latest writer on this subject says that if the initial vomiting be taken as the conclusion of the stage of incubation, it will be found to be under three days (Ashby, p. 248).

Symptoms.—The onset of scarlatina is usually so abrupt that its beginning may be fixed with considerable definiteness. There is possibly a previous slight duskiness of the skin, chilliness and malaise, but usually the first thing that attracts attention is vomiting, often without any relation to a previous meal; or there may be diarrhœa. Older children may not actually vomit, but complain of nausea, languor, headache, and sore throat, and feel chilly, although the face is flushed, and the thermometer may show a temperature as high as 103°–105° F. If such children are also drowsy, they may become delirious in their sleep. The pulse is full and strong (120–160), the skin is hot and dry, and the throat feels stiff and uncomfortable, and, if examined, will show a characteristic punctate redness. Such is the ordinary onset of a typical case of scarlet fever, but there is no disease of childhood that is liable to wider and more eccentric variations in its onset and course,

PLATE VIII.

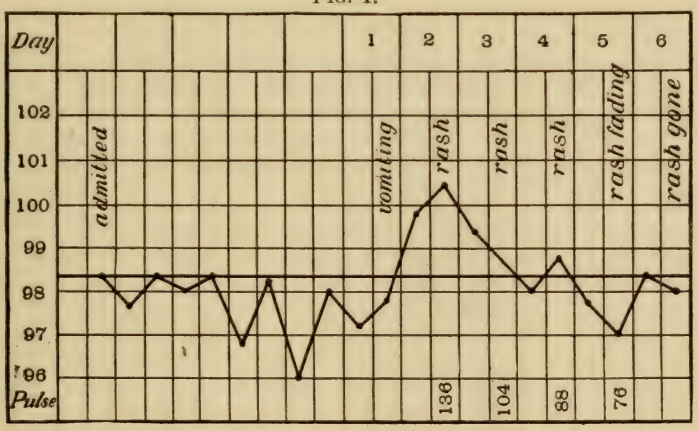


SCARLET FEVER.

oscillating between the very slight abortive form and that frightful variety called by the French *foudroyant*, or scarlatina fulminans, fortunately rarely met with; for in such cases the child succumbs, mortally poisoned from the very first by the virulence of the scarlatinal virus, without any prodromal stage or hardly any symptoms except those which may be referred to the nervous system. These dreadful cases often run their entire course in from thirty-six to forty-eight hours without eruption or sore throat, the only symptoms being nausea, dizziness, loss of consciousness, coma, violent delirium, or convulsions attended with abnormally high temperature (107°).

Scarlatina simplex may be differentiated in twenty-four hours by the appearance of the typical scarlatinal rash in the form of a scarcely perceptible scarlet flush or pin-point eruption, very closely resembling in color and stippling the shell of a freshly-boiled lobster. The eruption usually begins on the neck or cheeks or small of the back, and ought in forty-eight hours to spread nearly over the body, either as a well-defined blush or in scarlet patches—*scarlatina lævigata.* Plethoric and blond children develop the rash most promptly, and in all cases its color is heightened by the warmth of the bed, by hot baths, or by crying. A characteristic white line remains for a few seconds after drawing the edge of the nail or the point of a pencil over the rash. This typical line is supposed to be due to a paralysis of the vaso-motor

Fig. 1.



Temperature Chart in a Mild Case of Scarlatina. Patient 6 yrs. old. (After Ashby.)

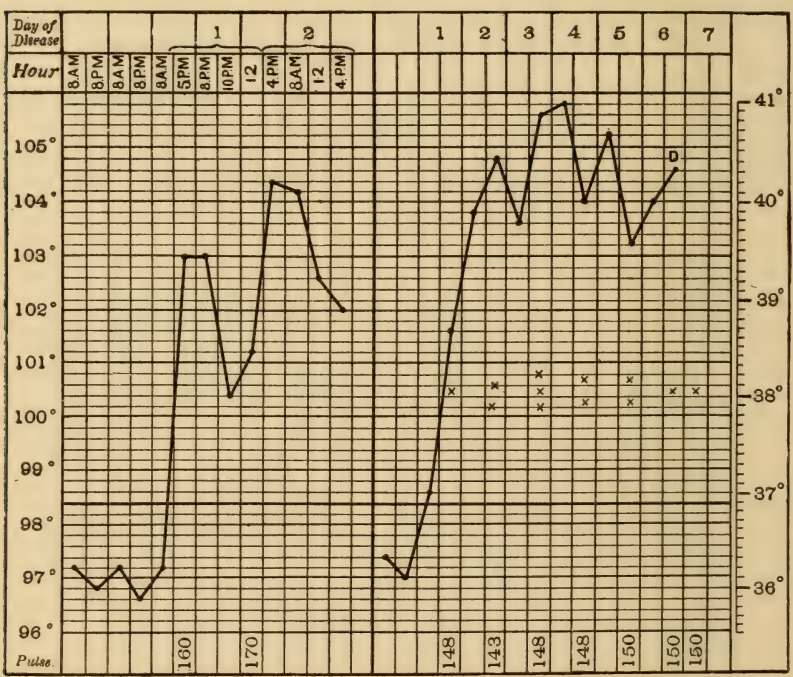
nerves of the capillaries in these congestive areas. Until the eruption is well marked the fever continues high, often dangerously so, as it is not unusual to find the temperature in impressible children marking 105°–107° F. The pulse is quick and sthenic, except in cases of scarlatina maligna, where there may be general depression, delirium, and collapse from the very onset of the disease. The pulse, as a rule, is faster than the temperature would apparently call for, ranging from 130–150, its relation to the rash and temperature being well shown in the accompanying chart, taken from Ashby (Fig. 1). Pharyngitis, with more or less soreness of the throat, is always present, although it may not be sufficiently painful to cause the child to complain (*scarlatina sine angina*). The respiratory organs, except the throat, are rarely involved, so that cough is generally absent. When present, it is due to faucial irritation, except where pneumonia occurs later as a dangerous complication. The tongue is the so-called strawberry tongue—that is, covered with a white fur with bright red tip and borders.

When the papillæ are greatly swollen, they cause the granular appearance known as the raspberry tongue. Some writers speak of a pathognomonic sweetish odor of the breath which may be detected at this time, but this is by no means an invariable symptom nor one upon which much reliance should be placed.

In a simple, uncomplicated case the fever and all threatening symptoms moderate with the appearance of the rash, with the exception of a slight evening febrile exacerbation, and any variation from this rule betokens malignancy or some new complication.

From the fourth to the sixth day desquamation ordinarily begins. Those areas which are first reddened fade in like order, and, as the color disappears,

FIG. 2.



Temperature Chart of Malignant Scarlet Fever. Death in 24 hrs. (After Ashby.)

Temperature Chart of Malignant Scarlet Fever. Death on 7th day. Rash indicated by *.

the skin is found to be covered with loose branny scales. These scales drop off imperceptibly, except when from itching, as is apt to happen on the face and neck, they are scratched off, and the tender epidermis beneath becomes cracked. In such cases the scales may be thrown off in shreds, or casts of the entire lip, fingers, or palms of the hand may be shed. A like desquamation occurs from the membranes of the throat, trachea, kidneys, and intestines, though of course the epithelial scales in these localities are carried away in a softened, macerated condition.

Out of 200 cases reported, 11 reached their highest temperature on the first day, 76 on the second, 75 on the third, 36 on the fourth, and only 2 on the fifth day. When the highest temperature is reached after the fifth day, or if the temperature has not fallen considerably by that time, some complication is certainly keeping it up, so that the thermometer and violence of the nervous

symptoms form a valuable criterion as to the danger of the child. A dull, apathetic condition is, as a rule, more to be dreaded than the usual restlessness, which is due to continued reflex irritation of the rash. In hyperæsthetic children this produces twitching, or even eclampsia, which is graver the later it occurs in the disease.

Variations.—We have previously described what might be considered a typical case of uncomplicated scarlet fever, but, unfortunately, uncomplicated cases are so rare that there is no disease of wider variations in every symptom.

The *eruption* may be so light as to escape detection, or, on the other hand, instead of the ordinary scarlatina lævigata, the eruption may appear in the form of small nodules (*scarlatina papulosa*), in which the papillæ of the skin are swollen, and the whole body looks as if covered with goose-skin. Or, again, these papillæ may become covered with vesicles, and we have that form of scarlatina which is known as *scarlatina miliaria*. Should these vesicles become merged together, they give an eruption to which the name of scarlatina *pemphigoides* seu *bullosa* is given. Such variations are found most frequently on the face, and are usually of grave import. Vogel reports exceptional cases in which the eruption was intermittent in character, appearing only at certain times of the day, and for this he proposes the name of *scarlatina intermittens*. Lastly, we may find that fatal form to which the name of *scarlatina petechialis* seu *hæmorrhagica* has been given, where there is an actual extravasation of blood into the skin, and hence the popular name of "black scarlet fever" by which it is sometimes known. In nervous children it is not infrequent to find urticaria accompanying scarlet fever, masking the characteristic rash. Vogel also reports a curious variation of scarlatinal rash in which are found sharply-marked, isolated areas which remain milk-white in color, or at least much whiter than normal integument, due to a temporary paralysis of the arterioles similar in character to that which follows the thumb-nail mark on the normal scarlatinal flush; but they are more persistent in character and are usually of unfavorable portent. Any intercurrent disease, as entero-colitis, which produces a determination of blood from the surface of the body, may greatly delay the appearance of the rash or render it so light that its differentiation will be difficult.

Complications.—*Throat.*—The angina of scarlet fever may assume any form, from simple catarrhal injection to extensive necrotic destruction of tissue. Ordinarily, a bright red flush, with punctate marks, such as might have been produced by a small brush dipped in red ink and dotted over the pillars of the fauces, is the earliest and one of the most characteristic symptoms of scarlatina. This may proceed no further than to give slight difficulty in swallowing and to impart a nasal tone to the voice. But, on the other hand, and more frequently—especially if pharyngeal disinfection is not practised from the very first—the swelling becomes so great as to make swallowing almost impossible. In such cases fibrinous exudates appear on the tonsils and fauces, and should the inflammation not be limited to the palate and fauces, the exudate may extend into the post-nasal cavities, the larynx, and even into the œsophagus and stomach. More frequently it proceeds through the Eustachian tube into the internal ear. (See Otitis Media.) The differentiation between the fibrinous exudate of scarlatina and true diphtheritic membrane is by no means easy, the more so since undoubtedly true diphtheria is not infrequently grafted upon the necrosis of scarlatinal angina; but it may be helpful to remember that the exudate of scarlatina is yellowish and pultaceous, rather than the ashy-gray membrane of true diphtheria. Should the presence of Loeffler's bacillus

be finally accepted as pathognomonic of diphtheria, the differentiation may then be made absolutely; whereas at present we must frequently remain in doubt, since the removal of the scarlatinal exudate leaves the superficial layers of the pharyngeal mucous membrane denuded and bleeding exactly as in diphtheria. A similar gangrenous process may proceed upward into the pharynx or along the Eustachian tube into the cavity of the middle ear, with all the perils of purulent meningitis which this implies. Similarly, as in true diphtheria, the exudate may pass downward into the larynx, where its presence is made known by a characteristic croupy metallic cough. If the exudate attacks the nasal cavities, this is attended by a profuse excoriating discharge, which soon grows purulent and offensive in odor.

Adenitis.—All forms of scarlet fever are attended with inflammation of the lymphatic glands of the neck, and, as a rule, it will be found that the involvement of these glands bears a direct relation to the severity of the throat lesions. So we find all grades of adenitis, from the slight induration which may be found accompanying all varieties of scarlatina, to a brawny swelling of the glands and cellular tissue embracing the whole neck. Such extensive mischief betokens like serious necrotic processes taking place within the pharynx, where the poisonous débris clogs and inflames the lymphatic glands, their pressure and morbid processes inflaming contiguous tissues. This cellulitis may extend from ear to ear, until deglutition becomes difficult and wide opening of the mouth impossible. If relief does not come early by resolution, the widely-distended tissue gives way to suppuration or gangrene, and death from hæmorrhage or septicæmia occurs.

Scarlatinal Arthritis is not infrequently met with in certain epidemics of scarlet fever during both the eruptive and the desquamative stage. This form of arthritis attacks by preference the knee- and elbow-joints, and scarcely can be distinguished by its objective symptoms from ordinary articular rheumatism, being, like it, excessively painful. But arthritis rheumatica rarely ends in pyæmia or permanent articular osteitis, as arthritis scarlatinæ is very prone to do.

Diarrhœa and Dysentery are not at all infrequent complications after the crisis of the disease, probably being caused by desquamation of the intestinal epithelium, analogous to that which undoubtedly occurs in the tubuli uriniferi at this time.

Scarlatinal Nephritis.—Last and, justly, the most dreaded of the complications of scarlatina, is that form of nephritis which so frequently occurs during the course of the disease that it may almost be considered pathognomonic; for a mild grade of renal catarrh is as constantly present as is desquamation (Steiner). It is true this frequently escapes observation and passes on to recovery without special treatment, but its existence is always a potential cause of morbus Brightii scarlatinosus, which should be considered not as a distinct disease, but as an intensification of the previous catarrh of the tubules brought about by chilling of the skin, etc. (Bohn).

Similar nephritic catarrh has been noted in measles, small-pox, pneumonia, and other diseases, induced, as the writer believes, by the passage through the kidneys of irritating ptomaïnes generated in the body by the specific microbes of these diseases. The excretion of these or analogous compounds through the skin very likely gives rise to the characteristic rash, hence analogous lesions might be inferred for the kidneys. It is a well-known fact that the lighter the cutaneous rash the more liable are the kidneys to be seriously implicated, presumably from increased excretion of various ptomaïnes through organs now endeavoring to do the work of both skin and kidneys. Daily examination of

the urine should be made for at least two weeks in even the mildest cases of scarlet fever, and will show from the beginning of the eruption evidence of renal catarrh (epithelial débris and albumin), although the kidneys are apparently working normally. While the urine is high-colored and deposits copious urates, Dr. Gee claims that urea is not necessarily diminished. The chloride of sodium is lessened until the fourth to the sixth day, and phosphoric acid after crisis; while the urates or uric acid appear to excess during convalescence. In other cases the urine is cloudy, and contains fatty renal epithelia, more rarely hyaline casts, and red and white blood-corpuscles (only exceptionally albumin), all of which disappear usually with the disappearance of the eruption, but may progress to an actual catarrhal nephritis. This renal catarrh Bartel believes is due to a specific poison—ptomaïne (?)—circulating in the blood, which poison irritates the tubules of the kidneys in its passage through the Malpighian tufts, either directly or from irritating properties imparted to the urine before its percolation through the tubuli uriniferi. Others claim that the source of this irritation lies in certain specific micrococci circulating in the blood, being analogous to diphtheritic nephritis, which Oertel thinks due to bacterial emboli.

A diminution in the quantity of the urine is often the first thing that awakens the attention of the physician, if he makes it his duty, as he ought, to keep himself posted daily until the end of the third week. The normal amount of 800 to 900 c.c. per diem may fall suddenly to 100 or 50 c.c., or even less. Its color is yellowish-red, sometimes almost yellowish-green when cooled; turbid, or clearing up on standing, depositing a cloudy precipitate made up of kidney cells and casts, urates, and uric-acid crystals in varying proportion. At times the urine is blood-red or smoky brown, from the blood it contains. Under the microscope the precipitate is found to consist of varying quantities of kidney epithelia, partly normal and partly swollen and distended, cloudy, and undergoing fatty degeneration. Besides these there may be various forms and phases of casts, lymph-corpuscles, red blood-corpuscles, and the crystals of urate of sodium and uric acid. The quantity of albumin found in urine is deceptive, since in certain epidemics of scarlatina, even where dropsy suddenly appears, often only faint traces of albumin may be found in the urine. Or albumin may be entirely absent during certain times in the day, or even for several days at a time, or during the greater part of the disease. Or, again, unmistakable albuminuria may be present while the urine is clear and free from all other abnormal elements. It may even happen that frequent analysis of the urine for days may fail to show either casts, epithelial cells, or crystals, while all of these, together with albumin, may be found at a subsequent examination.

Scarlatinal dropsy is often the first warning of the existence of any kidney lesion in mild cases which are supposed by parents, and even by the physician, to be well along in convalescence. As a rule, the chief danger of scarlatinal nephritis lies about the end of the second week or during desquamation, though dropsy may appear as late as the fifth or sixth week. The first symptoms noticed are slight œdema of the face and swelling of the eyelids. These are followed by puffiness of the backs of the hands and feet, sometimes unilateral, with dropsical enlargement of the abdomen. In the case of children who have not yet been allowed to rise from their beds the anasarca is often most marked in the back and in the genitals, which may become frightfully swollen and sensitive. As a rule, the kidney complication is ushered in with a return of fever, or an increase in fever, if it still be present. But there is also a feverless nephritis, without subjective symptoms, loss of appetite, or anything abnormal that can be detected. In other cases there is only an evening

increase of temperature and pulse. Generally the skin is dry and ceases to desquamate. Pain over the kidneys is seldom complained of, unless questioned about or obtained by pressure. If the disease in the kidney is limited, there may be only a localized œdema, such as hydrothorax, hydrops pericardii, œdema of the lungs, or dropsical effusions into joints. This localized œdema may follow a brief apparent convalescence, during which children recover their appetite, and exhibit no features of illness, unless it be the persistence of slight lassitude and fever at night. After exposure to cold such cases develop anorexia, depression, and pain over one or both kidneys. The amount of urine is greatly diminished. It is concentrated, high-colored, and contains albumin and casts, and may not measure more than an ounce for the entire day, or may even be completely suppressed. About 6 per cent. of all scarlatina patients suffer from post-scarlatinal nephritis, the course and duration of which depend directly upon the extent of the anatomical lesions of the kidney. Very light cases recover in a few days. Generally the anasarca and effusions increase for several days—say a week and over—breathing being hindered by the ascites and pleural effusions, and the nights are restless. Œdema of the lungs provokes incessant coughing. Swelling of the genitals is often painful, but does not noticeably interfere with urination. Death may ensue suddenly from uræmic convulsions when danger is least expected. Ashby attempts—and it seems wisely to the writer—to differentiate between septic and post-scarlatinal nephritis, either of which may be met with during the course of scarlet fever. The urine in the first contains no blood-corpuscles, but is highly albuminous, and is not attended with dropsy nor uræmic convulsions. Autopsy in these cases shows a distinctly softened, pyæmic kidney, which contains minute abscesses, and is mottled in its cortex with injected blood-vessels and inspissated pus. Death occurs from pyæmia, and not directly from the kidney lesions, which are only a part of the more general process. In the second class of cases death results from uræmia. The lesions of the post-scarlatinal kidney have been fully described under Pathology.

Sequelæ.—*Chronic nasal catarrh*, ozæna, pharyngitis, or hypertrophy of the tonsils, with acute attacks of quinsy, or suppurative otitis, with chronic otorrhœa and deafness, more or less complete, are among the dreaded reminders left after scarlatina, especially where the angina has been malignant. In many such cases the tonsils become deeply excavated, and the soft palate sloughs; but even under these circumstances recovery is possible. Or, as has previously been noted, diphtheritic-like membrane may cover the fauces, palate, and even spread on to the epiglottis and into the larynx. Death from exhaustion or hæmorrhage usually terminates such cases, or, if life is for a while prolonged, death comes later from septicæmia, often terminated by septic pneumonia (seventh to fourteenth day). But even septic pneumonia is not necessarily fatal, for recovery took place in one of the writer's cases after the appearance of this sequel subsequent to otorrhœa and cervical abscesses and sloughing. The amount of damage sometimes inflicted by these cervical sloughs is frightful. Smith speaks of one which laid bare the carotid and produced death by its perforation. Williams relates a still more remarkable case, in which superficial ulceration of the fauces, palate, and tongue was conjoined with suppuration of the lymphatics of the neck. This was followed by sloughing, exposing, in the triangle of the neck, a space bounded by the edge of the sterno-mastoid, the upper border of the thyroid cartilage, and the median line of the neck. Nevertheless, under antiseptic treatment, the boy made a good recovery, although he was only six years of age and had previously been considered delicate.

Broncho-pneumonia, pleuro-pneumonia, empyema, and peritonitis are among

the possible complications of scarlatinal nephritis. If the temperature runs high, the tongue becomes dry and brown, the urine scanty and albuminous, and death rapidly ensues. But milder cases are not hopeless if the urinary secretion can be re-established.

Cardiac dilatation, endocarditis, and pericarditis are the more frequent heart-lesions that should be guarded against in every scarlatinal nephritis, for, conjoined with increased arterial tension and general malnutrition, they may bring sudden death either from heart failure or embolism. The possibility of such untoward termination to nephritis should never be forgotten, for no sharper reproach can come to the physician than the thought that had he allowed less work to be thrown upon a weakened heart he might have carried his patient into safe convalescence.

Otitis, with perforation of the membrane, more than any other sequela, has too often been left a lifelong reminder of scarlet fever. In many of these cases little pain is complained of, although the fever remains suspiciously high until a purulent discharge from the ear makes its appearance. Mastoiditis or purulent meningitis may prove fatal, but in a majority of these cases no such complications take place, and the child recovers, more or less deaf or afflicted with a chronic otorrhœa. According to Batut, statistics in Belgium show that out of 1892 cases of deafness, 216 followed scarlet fever. Another observer found out of 400 cases 144 due to the same cause.

Synovitis has already been referred to under the head of Arthritis, as liable to occur about the second week. Suppuration and pyæmia are the chief dangers in these cases.

Cerebral lesions, such as paralyses, blindness, aphasia, loss of memory, hemiplegia, etc., are among the sad sequelæ of the uræmic convulsions of scarlatinal nephritis.

Convalescence from severe cases of scarlatina is always protracted, the subsequent anæmia lasting for months or years, especially in scrofulous children, in whom the virulence of the poison is most lasting in its effects. Many of the most discouraging cases that come into the hands of the physician dealing largely with the diseases of children are those in which the child's vitality has been undermined by malignant scarlatina. Such children frequently suffer for years from the so-called mucous disease of Eustace Smith or from renal incompetence. In other cases there is a chronic otorrhœa or offensive ozæna, which renders their lives miserable, and so saps their vitality that they succumb easily to intercurrent disease. This is especially true of those children in whom the functions of the kidneys have been seriously crippled by post-scarlatinal nephritis. Such a previous history always awakens serious apprehensions in the presence of diphtheria, typhoid, or any septic disease.

Diagnosis.—The early diagnosis of a mild case of scarlet fever is often a matter of great difficulty, but it is a matter of no little importance to the patient, for such mild cases seem to be the ones most liable to nephritic complications. Since mild cases may communicate dangerous attacks to those more susceptible, it is always safe to give the well children the benefit of your doubt by isolating all suspicious cases. Nausea, pain in swallowing, and fever constitute a trio of symptoms sufficient to isolate a patient until a rash of some kind appears. This may be so light and transient, especially if there be coincident diarrhœa, that it may escape detection unless carefully watched for; and even then there is an *erythema scarlatiniforme* that without previous history may deceive the very elect in pædiatrics. In such cases, however, the throat does not show the characteristic stippling of scarlet fever, and a brisk emetic or purge brings the case to a speedy termination. The early differentiation of

rubella from scarlatina is often puzzling, but Jamieson calls attention to the fact that in rubella the characteristic tongue of scarlet fever is absent, while the mild catarrhal symptoms of the former are not ordinarily present in the latter disease.

The eruption of measles is most distinctly patchy, and is preceded by several days of drowsiness and the symptoms of an ordinary cold. But in all doubtful cases isolate and wait for light, remembering "that nephritis occurring after an anomalous rash makes it practically certain the primary attack was scarlet fever." Broncho-pneumonia under similar circumstances justifies a diagnosis of measles.

Prognosis in scarlet fever must be largely influenced by the character of the then prevailing epidemic and the general condition of the child. The virulence of the scarlatinal poison and the susceptibility of the one attacked determine the degree of restlessness, jactitation, and delirium observed. Initial eclamptic attacks rarely occur, except in unusually nervous, susceptible children, and their occurrence is of very unfavorable portent.

As a rule, the early and extensive implication of the cervical lymphatics is a forerunner of serious throat complications. Nasal diphtheria complicating scarlatina is of the gravest import, and the gravity is proportionate to the early age of the child, children under four years giving as high a mortality as 28 per cent. The younger the child the more guarded should be the prognosis, especially when associated with diarrhœa, which is regarded by Ashby as a very serious symptom.

Where the temperature continues high (104°–106°), and there is much diarrhœa or extreme restlessness, or the angina is malignant, the prognosis is always grave. Drowsiness is always an unfavorable symptom, and a high temperature continued into the second week is sufficient ground for anxiety.

Desquamation is seldom completed before the sixth week, and is not always at an end in twice that time, Finlayson fixing the infective period of this disease as seven to eight weeks.

The nephritis complicating or following scarlet fever is more dangerous than the primary disease. Where persistent vomiting occurs, not only on the first, but on subsequent days, the prognosis is correspondingly grave.

Post-scarlatinal nephritis is the most favorable form of parenchymatous inflammation of the kidneys, usually ending in recovery in two or three weeks by means of copious diuresis, but it is worth remembering that the excessive excretion of uric acid, which persists well into convalescence, may form gravel or calculi. As a rule, epithelial casts and detritus persist after the disappearance of the albuminuria, sometimes for an exceedingly long time, especially in cachectic children.

Death rarely occurs before the fourth day, and usually not later than the seventh, except from post-scarlatinal nephritis. Sudden death may result from rapid and uncontrollable increase of dropsy, either into the peritoneum, pleura, pericardium, or ventricles of the brain, or from œdema of the lungs or glottis. Or, stopping short of immediately fatal results from œdema, the end may come more slowly from inflammation of the lungs or pericardium, or still more slowly from gangrene of the genitals or from bed-sores. Or, as may be inferred from the above, the nephritis may assume a chronic form.

The relation between the intensity of the scarlatinal eruption and the danger of subsequent nephritis is by no means constant, although the writer has come to dread its appearance in the lighter cases because these are the ones in which the care of the parents is apt to be relaxed with the apparent rapid convalescence of the child.

Serious cerebral affections, such as paralysis, blindness, aphasia, loss of memory, hemiplegia, may remain as sequelæ of scarlatina.

Mortality varies widely with the epidemic. That in the Manchester Children's Hospital varied from 6 to 25 per cent. according to the epidemic, the average for ten years (1877–87) being 11.8 per cent. Of 10,000 cases reported by Collie, the mortality was 12.5 per cent. for all ages, that between three and four years reaching as high as 25 per cent.

These figures, it must be confessed, are too high for the average American practitioner, but he may, like foreign physicians, be compelled to radically change his ideas on the subject. Brettonneau, for instance, up to 1799 thought scarlatina the mildest of all the exanthemata; and so also the Irish physicians thought from 1804 to 1831. But Brettonneau was obliged to entirely change his views after encountering the fatal epidemic at Tours in 1824; and a similar outbreak in Dublin in 1831 completely revolutionized the views of the Irish physicians in regard to the fatality of scarlet fever.

Treatment.—A hopeful fact, always to be borne in mind in any choice of treatment adopted in scarlatina, is that it is a self-limited disease, and that no remedy has yet been discovered that will either abort or greatly modify its course. The medical literature of the past twenty-five years teems with alleged specifics, but all of these by subsequent trials have been found no better nor worse than those proposed before them. Nevertheless, the intelligent physician owes it to himself and his patients that he shall not desert them upon the rocks of medical agnosticism nor wreck them upon the snags of polypharmacy. If he cannot abort the disease, he may make its course less uncomfortable to his patient, and by careful foresight ward off many a threatening complication.

Diet is not unimportant in scarlet fever, for our aim from the very beginning should be to tax the kidneys, already in a catarrhal condition, as little as possible with nitrogenous materials. Hence the ideal food for the scarlet-fever patient is koumyss, skimmed milk, or milk and Vichy. But the ordinary American child will not long tolerate such light diet, especially when rapidly convalescing, so we are usually forced to add to our diet-list broths, soups, light puddings, and baked apples, happy if thereby we reduce meats to a minimum. While the writer cannot agree with Jaccoud that a milk diet is an absolute safeguard against post-scarlatinal nephritis, it is true that a liquid diet and warmth should be carefully secured for at least four weeks.

General Treatment.—If the initial nausea is vexatious, it may often be allayed by:

℞. Aquæ cinnamomi . . . . . .
Liquor calcis . . . . . *āā* f℥j.
Tinct. gelsemii . . . . . f℥ss.—M.
Sig. Teaspoonful every hour.

For the high arterial tension and fever, tincture of aconite, given according to the plan of Ringer—*i. e.* a drop every quarter hour until arterial tension is decreased, and then given sufficiently to hold the pulse at that point every two or three hours—is very satisfactory.

Chloral hydrate is a favorite with the writer, almost entirely displacing the tinct. ferri chloridi of his earlier practice, except in those cases where there is malignant angina from the beginning. In such cases nothing has been found superior to the tincture of the chloride of iron (one drop per dose for each year of the child's age), with whiskey or brandy, given according to Dr. Chapman's plan. The surprising tolerance of such children for alcoholic stimulants

shows that their power is expended otherwise than in their usual effects upon the brain. Many such children will take f℥ss of brandy every hour without showing any of the usual physiological effects. In ordinary cases, however, small doses of chloral hydrate seem to be all that is necessary to relieve restlessness, moderate the angina, and, to a limited degree, act as an antiseptic. For the first forty-eight hours such a prescription as the following has often proven most useful:

℞. Chloral hydrate . . . . . ℥ss–j.
Camphor water . . . . . f℥ss.
Syrup of orange-peel . . . . . f℥iss.—M.
Sig. To alternate with aconite as required.

When the eruption is tardy in appearing, a hot salt or mustard bath will expedite matters, or, if these are ineffectual, packing in a sheet wrung out of hot water and sprinkled with mustard rarely fails.

The throat is too often neglected, and yet here is the focus from which spread many of the dangerous complications of this disease. Local antiseptics may be a modern device, but Underwood came very near to the writer's ideas when he wrote on this subject many years ago: "The throat must be often syringed with . . . . though the quality is perhaps of far less importance than its being frequently made use of, which is absolutely necessary, especially in young children. . . . . Even syringing the throat with hot water is found to administer immediate relief." The local treatment of the throat with peroxide of hydrogen spray, as directed under the head of Prophylaxis, can hardly begin too early, and the same may be said of the inunction of the body with some antiseptic ointment. Quinine internally may be added later if there is evidence of failing strength.

Cerebral symptoms, unless associated with scanty urine, may be rendered tolerable by the addition of bromide of potassium (grs. v-x) to each dose of the chloral hydrate mixture, with a mercurial purge and the application of cold to the head. Phenacetin is sometimes a great comfort in such cases, but the writer discourages the use of the other antipyretics in scarlet fever, except as a last resort in abnormally high temperature. Even in these cases persistent sponging with cool water, or even cold affusion, ought first to be tried. Persistent drowsiness always awakes suspicion as to post-nasal complications, and emphasizes the necessity of nasal irrigation, frequently repeated.

Scarlatinal arthritis in cachectic children may proceed to suppuration and destruction of the joints, but, fortunately, most of these cases are more painful than dangerous, and yield promptly, like true rheumatism, to fair doses of salicin and codeine and wrapping the affected joints liberally with cotton batting.

Cervical adenitis is more frequently overtreated than neglected, for the swollen and tender glands apparently require immediate attention. And yet the trouble lies farther back, for the débris that blocks these inflamed glands comes usually from the pharynx. Hence efficient pharyngeal and nasal cleansing will do more for adenitis than poultices, lotions, or ointments. So-called energetic treatment too often precipitates the very troubles we are seeking to guard against. Instead of poultices and iodine, simple rest and warmth will often work wonders even in brawny, swollen necks where suppuration appears inevitable. At all events, camphorated oil, applied on absorbent cotton, should be tried before proceeding to more vigorous measures.

Diarrhœa is apt to be quite persistent, and occasionally painful, when once

it makes its appearance. So far, I have rarely seen it assume a dangerous aspect, for it usually can be held in check with paregoric alone or conjoined with bismuth in an emulsion.

Scarlatinal Nephritis.—Individuals and epidemics of scarlet fever vary so greatly in their liability to nephritis that it is difficult to rightly estimate its prophylactic treatment. From 60 to 70 is given by various authors as the average percentage in dangerous epidemics, and from this it falls to 6 or 7 per cent. in ordinary cases. The writer believes that this latter proportion can be still further reduced by the proper care of children in the mildest form of the disease, for these are the very ones which give us the highest proportion of fatal cases of nephritis. It follows, then, that all children ill with scarlet fever should be kept in bed during the rash, no matter how mild it may be; and, furthermore, such children should be confined to warm rooms, or, better still, to bed, for four or six weeks from the appearance of the initial symptoms. At least twice a week during this time the urine should be examined, and upon the appearance of the slightest unfavorable symptom the child should be sent back to bed again if he has already been allowed to be about the room.

But should these premonitory symptoms be disregarded, or if, in spite of these precautions, scanty albuminous urine and dropsical effusions appear, then the physician's most energetic efforts must be directed toward making the skin or intestines temporarily assume, as far as possible, the functions of the kidneys, throwing on the latter, at the same time, as little work as possible in the way of the excretion of nitrogenous refuse. (See Diet.) The copious use of water, if tolerated by the stomach, will act as one of the very best of the diuretics. Long ago Roberts placed pure spring water at the head of the list, and the writer has not yet found any diuretic to displace it, though lemon-juice, raspberry vinegar, or skimmed milk may be added without harm to induce the child to drink more freely of the water.

Should the urine still remain scanty, then *diaphoresis* must be induced in order to increase the action of the skin—first, by means of baths, and then, if necessary, by drugs. A warm bath (98°–100° F.) for fifteen to twenty minutes is often grateful to the child, and, if supplemented by a flannel pack, is very efficient. The hot-air or steam bath, as described under the treatment of Acute Nephritis, may likewise be employed with success. Any of these methods will be assisted by the internal use of diaphoretics, chief of which are the preparations of jaborandi. Sips of a hot infusion of the leaves (℥j to Oj) act both as a powerful diaphoretic and sialagogue. To avoid the latter action Smith prefers the alkaloid pilocarpine, $\frac{1}{40}$ to $\frac{1}{20}$ grain, conjoined with an alcoholic stimulant every four to six hours. Should this fail, the same writer speaks highly of the following prescription:

℞. Potassii acetatis . . . . . .
Potassii bicarbonatis . . . . . .
Potassii citratis . . . . . *āā* ℥ij.
Infus. tritici repentis . . . . . f℥viij.—M.
Sig. Teaspoonful every three or four hours to a child of five years.

More palatable and fairly efficient is the following:

℞. Liq. ammonii acetatis . . . . . .
Syr. acidi citrici . . . . . *āā* f℥ij.—M.
Sig. Teaspoonful every hour in hot lemonade.

Or, where there is considerable dropsical effusion, this can be with advantage alternated with diuretin (gr. j–iv), given in a large amount of water.

Dropsy usually requires, in addition, the free use of some hydragogue cathartic, of which the compound jalap powder (gr. v–x) is certainly the most efficient and unpleasant. Hence, when it is found impracticable to repeat the dose as often as required, it may be supplemented by a cream-of-tartar lemonade, made by dissolving a tablespoonful of the salt in hot water, diluting with an equal amount of cold, sweetening to taste, and adding sufficient claret or port to make agreeable. Most children will take this laxative readily.

Or the following prescription of J. Lewis Smith may be employed:

℞. Ol. cinnamomi . . . . . gtt. viij.
Magnesii sulphatis . . . . . ℥j.
Potassii bitartratis . . . . . ℥ij.—M.
Sig. One teaspoonful repeated from two to four hours, until catharsis occurs.

But the use of laxatives should be continued no longer than is strictly necessary, for their repetition brings anæmia, a result greatly to be deplored.

After relieving the initial congestion of the kidneys, stimulating diuretics are helpful; and of these digitalis has justly a high reputation. The infusion is a reliable preparation, and may be given in connection with acetate of potassium, as in the following mixture:

℞. Potassii acetatis . . . . . ℥ss.
Infus. digitalis . . . . . f℥vj.—M.
Sig. One teaspoonful every four hours.

Local treatment will also greatly help in relieving the fever and backache. Foreign writers speak highly of the use of leeches over the kidneys in these cases, but the majority of American physicians are willing to rely upon the use of poultices or plasters. A large warm flaxseed poultice, containing mustard or digitalis, often acts like a charm. Smith prefers one made of 1 part each of powdered mustard and ginger to 16 of ground flaxseed, and advises dry cupping when the child is not frightened thereby. Sluggish kidneys may be gently stimulated by capcine plasters or some mildly stimulating embrocation, and a flannel bandage worn day and night.

It ought never to be forgotten that while the liability to heart failure is not as great in scarlatinal nephritis as it is in the convalescence of diphtheria, yet it is a possible danger, and one from which death may rapidly occur. An irregular, flickering pulse requires absolute confinement to bed and the continued use of some chalybeate tonic. A pleasant one may be found in the following:

℞. Tinct. ferri chloridi . . . . . f℥iij.
Acidi phosphorici dil. . . . . f℥vj.
Glycerini . . . . . f℥vij.
Vini xerici . . . . . f℥iv.—M.
Sig. Teaspoonful four times a day.

Hæmaturia can best be controlled by gallic acid and ergotine, and threatening convulsions kept in check by rectal injection of chloral and bromide of potassium (gr. v and gr. x) in milk or water. Nitro-glycerine tablets ($\frac{1}{100}$ gr.)

are very valuable for temporary stimulation of the heart, and may be used hypodermatically if the need be pressing.

Prophylaxis.—All attempts to procure personal immunity by means of inoculation have up to the present time proved ineffectual. The same may be said of prophylactic medicaments, for it is more than doubtful whether any known drug has the power to prevent the occurrence, or to greatly modify the course, of scarlet fever after its incubation. Even Hahnemann's vaunted specific, belladonna, has failed so often and completely that it need only be mentioned as one of the curious delusions of medical history. The same may be said of sulphocarbolate of soda (Beebe's), quinine, salicylate of sodium, and the other alleged preventives which from time to time appear and disappear in medical literature. The fact is that epidemics of scarlatina vary widely in their intensity and danger. Hence it is that in one epidemic the liability to contagion is reduced to a minimum, and whatever may be used at that time receives credit for prophylactic powers which fail miserably when next put to the test. Our efforts must, therefore, be confined to isolation of the patient and disinfection of whatever touches or comes from him, for it must be remembered that not only the desquamatory scales, but also blood, serum, breath, urine, and fæces probably carry infection during the entire course of the disease.

Now, as every case of scarlatina, even the mildest, may communicate a dangerous form of the disease, it is always wisest that every case should be treated as if it might develop a most dangerous epidemic. Six weeks of quarantine are none too long for an average case of scarlatina, and this should be indefinitely extended as long as desquamation may require. Seven years' experience in one of the orphan asylums of Chicago has convinced the writer that this is not only theoretically possible, but actually does prevent the spread of the disease, for never during these years has there been a general epidemic of scarlatina in the asylum, although sporadic cases have been not infrequent. In such institutions isolation can be more effectually carried out than in private families, but the effort should be made, and is usually attended with the happiest results. Long ago Dr. Budd wrote in reference to scarlatina: "Time after time have I treated this fever in houses crowded from attic to basement with children, who have nevertheless escaped infection by the simple method of isolation." Reliable statistics show that 50 per cent. of the children thus protected escape infection, and still better results ought to be obtained by local and personal disinfection added to isolation.

Disinfection of the sick-room should never be omitted. For this purpose J. Lewis Smith highly recommends volatilization of the following mixture in boiling water:

℞. Acidi carbolici . . . . . .
Ol. eucalypti . . . . . *āā* f℥j.
Ol. terebinthinae . . . . . f℥vj.—M.
Sig. A tablespoonful to be added from time to time to a pan of hot water, to be kept boiling on a gas stove or grate fire.

The sick-room should be the largest, most sunshiny, best-ventilated room in the house, and, if possible, should have an open fireplace. All curtains, pictures, ornaments, and furniture not absolutely necessary for the comfort of the patient should be removed before the child is placed there, and no one but the nurse and physician allowed to enter. The nurse should wear a loose wrapper and cap, to be dropped inside the door should she be compelled to meet other persons for any purpose outside the door.

An ordinary bed-sheet, tacked by one edge over the door and kept moistened with a 2 per cent. solution of carbolic acid, has apparently been helpful in preventing the spread of the disease in asylum practice, where, the writer agrees with J. Lewis Smith, the "area of contagiousness is small, and hence the disease is more easily quarantined than either measles or pertussis."

For disinfection of the patient J. Lewis Smith recommends as a local disinfectant to the faucial mucous membrane corrosive sublimate, 2 grs. to a pint of water (1 drachm containing $\frac{1}{64}$ of a grain). This may be used as a gargle, or as a spray from a hard-rubber atomizer. The same solution may be employed for cleansing the nasal cavities. The writer's preference for faucial application is a solution of eucalyptol in peroxide of hydrogen (gtt. xv to f℥j), used in the cup of an ordinary steam atomizer. The same solution may be applied upon a swab to the fauces if there be extensive necrosis; or, diluted with an equal amount of water, it may be used for washing out the nares with a douche or fountain syringe.

Others speak highly of 50 per cent. boroglycerin for topical disinfection of the throat, and all sorts of more energetic disinfectants have been recommended (mineral acids, chlorine-water, galvano-cautery, etc.) with less obvious justification.

The frequent anointing of the body with some form of non-irritant antiseptic ointment in order that the action of the skin may be encouraged, restlessness allayed, and the scattering of the scales reduced to a minimum, is strongly advised. Such an ointment as carbolic acid, grs. 20, thymol grs. 10, to vaseline and lanoline each half an ounce, may be favorably employed. This should be applied at least twice daily, the skin having been previously cleansed with warm water in which a little soda is dissolved. J. Lewis Smith speaks highly of the following:

℞. Acid. carbolici . . . . . .
Olei eucalypti . . . . . *āā* ℥j.
Olei olivæ . . . . . ℥vij.—M.
Sig. For inunction every three hours.

Even the old-fashioned fresh lard or ham-rind will be found grateful to the patient and helpful to the health officers. An excellent and more elegant prescription is:

℞. Thymol . . . . . gr. x.
Ol. theobromæ . . . . . ℥j.
Alcohol . . . . . q. s.—M.
Ft solutio.
Sig. For inunction twice or three times a day.

Disinfection of the room in which the patient has been is scarcely less important than that of the patient, since the virus of scarlet fever is so tenacious in its potency that it will persist for years in houses or rooms not properly disinfected. If the walls are papered, they may be rubbed, as is done by paper-cleaners, with slices of rye bread, which will remove microbic spores and scales; or, better, if possible, they should be repapered, calcimined, or whitewashed. Previous to this, sulphur—1 lb. to each 100 cubic feet of room-space—should be burned in the infected apartment, which should be kept closed for eighteen hours thereafter.

The efficiency of sulphur dioxide as a disinfectant is greatly increased by

combining with it the vapor of water in a hermetically closed room (Squibb). Hence the room should be closed as tightly as possible by pasting strips of paper over the door-jambs and keyholes before burning the sulphur candles. To increase the efficiency of the sulphur dioxide by its union with aqueous vapor, the candles may be placed on bricks in an ordinary wash-tub partially filled with water, and allowed to burn in the closed room until they go out for want of oxygen. After the room has been opened and aired as fully as possible, it ought never to be reoccupied until the walls have been cleaned as previously directed or thoroughly scrubbed.

All sheets, bedding, towels, and articles that can be washed should be immediately thrown into boiling water after being used, and those articles that cannot be washed or boiled should be fumigated with sulphur, baked, or, still better, destroyed by burning, as should all toys and books used during the convalescence of the patient.

RUBELLA.

By WILLIAM T. PLANT, M. D.,
Syracuse.

Perhaps there is no other disease of brief duration and benign character that has been so much written about and so variously named as rubella. It was for so long held to be related to measles or scarlet fever, or both, that the following names have naturally come from such views of its nature: French and German measles or scarlet fever; false, bastard, and hybrid measles; and epidemic roseola. These and others not worth remembering have come down to us. The German name, Rötheln, is not, and will scarcely become, popular in America, because of its foreign appearance and difficult pronunciation. More attractive and satisfactory than all other names, and now quite generally adopted by English-speaking people, is that of *rubella*—a diminutive of rubeola, first suggested by Veale not many years ago. Indeed, the disease seems to have been waiting for a name, and only lately to have found a fitting one.

Previous to the middle of the last century rubella had had no very clear description or decided differentiation from measles, and almost down to the present time very many in the profession have regarded it as a sort of modified or mongrel measles. Now, however, through a happy agreement of medical opinion, the following points may be regarded as settled: 1st. Rubella, though much resembling measles and somewhat resembling scarlet fever, is a distinct entity, independent of these as of other diseases. 2d. It confers no protection against measles or scarlet fever, nor can either of these affections influence or prevent an attack of rubella.

Rubella is an acute, contagious, eruptive disorder, which runs its course quickly and terminates in recovery. It occurs, with few if any exceptions, but once in a lifetime. It commonly occurs in epidemics of rather limited extent, though sometimes it spreads over large tracts of country in a short time; and not infrequently the observant physician encounters sporadic cases whose origin he cannot make out. At times it appears to part with its tendency to spread, though probably at all times its contagious property is less pronounced than that of measles.

All ages are liable to it, adults nearly or quite as much so as children. Its incubation seems not to be definitely known, or perhaps the time is not fixed, but variable. Writers state it as from one to three weeks.

Symptoms.—The disease begins rather abruptly. When it follows its typical course there are at first shiverings, feverishness, aching of head, back, and limbs, loss of appetite, and sore throat. These prodromal symptoms seldom last longer than twenty-four hours before the eruption appears. It is to be remembered also that in many instances—and in children, perhaps, in most instances—the eruption appears as the initial symptom, without previous chilliness, fever, or pain or any complaint whatever of illness. When there is fever, it often subsides almost completely within one day after the coming out of

the eruption. Indeed, the affection is not attended at any part of its course by much rise of temperature—seldom more than three degrees and often less than one degree. The eruption, first observed on the forehead and face, extends rapidly over the neck, trunk, and limbs. The rash is papular, and the papules vary in size; the average is rather smaller than the eruption of measles; dots and points are interspersed with blotches the size of lentils or small split peas. The eruption is slightly raised above the surface, like that of measles, and is red in color, rather brighter than that of rubeola. In some instances it is sparse and rather pale; in others high-colored—rose-red—and so abundant that some of the papules touch at their edges and form blotches of considerable size. These never arrange themselves crescentically, as the eruption of rubeola so frequently does. It should be remembered that the eruption of rubella is multiform; sometimes it is punctated, and so fine as to resemble scarlatina more than rubeola. The duration of the eruption is variable, the average being probably between three and five days. Often it wholly disappears within three days. When the rash is abundant and high-colored, it is apt to remain rather longer, and in such cases intense itching may be a prominent feature. The eruption is seldom followed by desquamation except of a very light, branny character.

Sore throat is an almost constant symptom in rubella, and appears early. The pharynx is inflamed and the tonsils are red and swollen, and there is more or less pain in swallowing. This angina is usually slight, and subsides quickly, often to recur in the last stage of the disease. This secondary sore throat, when present, according to Eustace Smith, is extremely characteristic of rubella. There is, besides, a characteristic enlargement of the superficial cervical and posterior auricular glands. Almost all writers have alluded to this symptom: it is so generally present that it may be regarded as diagnostic. Griffith, however, believes that this glandular swelling, while a very constant symptom of rubella, is probably nearly equally as frequent in rubeola, and that it is by no means of as great diagnostic importance as is usually supposed.

In some cases many glands about the neck are enlarged, in others only one or two. There is also, in many cases of rubella, a slight coryza and some conjunctival congestion.

Diagnosis.—Except that rubella, as a late author says, may be "mistaken for some of the anomalous erythematous or roseolous rashes" that children sometimes have, there is no danger of its being confounded with anything else but mild measles, or, possibly, with scarlet fever. Perhaps the patient has already had these diseases; in that case he is little liable to them again. Perhaps rubella is prevalent; if so, the chances are in its favor. The prodromal stage in rubella, if present at all, is very short; the fever short and often absent; the tight, resonant, bronchial cough, so constantly present during measles as to make a part of its history, does not belong to rubella. The eruption is smaller, more multiform, and lighter in color than that of rubeola, and is never, like it, concentrically grouped. The sore throat and swollen cervical, post-auricular, and submaxillary glands that are all but constantly present in rubella do not belong to measles; nor is its rash so scarlet or finely punctated as that of scarlet fever.

It frequently happens that rubella resembles scarlet fever more than measles. In this case there is a diffuse red rash and some faucial inflammation. The rash, however, is not punctiform as in scarlatina, but erythematous in character, and in certain localities, particularly the neck and the dorsum of the hands and feet, it is papular, or at the least rough. The differentiation is most troublesome when the eruption is declining.

Treatment.—Probably no disease needs less medical treatment. Its own direction being toward recovery, it may generally be safely left to follow it. The patient should be sent to bed, as well for the safety of others as for his own. As there is conjunctival irritation in most cases, the room should be darkened.

The diet should be light and bland, as toast, hot bread and milk, and various broths. Cool water should not be denied. If itching be troublesome, it may be allayed by frequent tepid bathing. Treat headaches by applying cloths wrung from cold lotions, or by hot foot-baths made more effective by mustard.

The sore throat is well treated by the steam atomizer or by gargles, as follows:

℞. Potassii chloratis . . . . . ʒiss.
Glycerini . . . . . fʒiij.
Tinct. ferri chlorid. . . . . fʒss.
Aquæ . . . . . q. s. ad fʒviij.—M.

Sig. Gargle once in three or four hours.

CHICKEN-POX.

By WILLIAM T. PLANT, M. D.,

Syracuse.

Varicella, or chicken-pox, the lightest of the exanthemata and the most trivial of diseases, was first described as a distinct affection a few years before the close of the seventeenth century. There can be no doubt that it had existed from a period far remote, but it was not until then differentiated from small-pox and other eruptive disorders. Dr. William Heberden, an English physician who lived between 1710 and 1801, was the first to give a full and accurate description of this disease, though several writers before his day had described it less perfectly, and one of them, Dr. Richard Morton, gave it its earliest and best name of chicken-pox.

It is an infectious, acute, and transient affection, runs a definite course, and, with very few, if any, exceptions, occurs but once in the same person. Though it bears some resemblance to the lighter forms of variola, it has no real relation to this disease, as has been abundantly proven by the observations of two centuries. Therefore, the name varicella, conferred upon it by Vogel in 1764, is founded upon error and is misleading.

It is essentially a pediatric disorder, as it only affects infants and young children—at least the writer does not remember to have met with it more than once or twice in adults. It may be regarded as quite a rare affection after fourteen or fifteen years of age. It travels in epidemics, often widespread, regardless of season, race, country, or climate, and of everything but age.

Incubation.—The incubative period is rather long. Henoch fixes the duration of this period at 12 to 13 days; Gerhardt, 14 to 15; Eichhorst, 13 to 16; and Strümpell, 13 to 17. In cases of the inoculated disease d'Heilly has observed as short an incubation as 3 days; but with the affection as ordinarily contracted this period of latency may be assigned between the lowest and highest figures given by the authorities quoted.

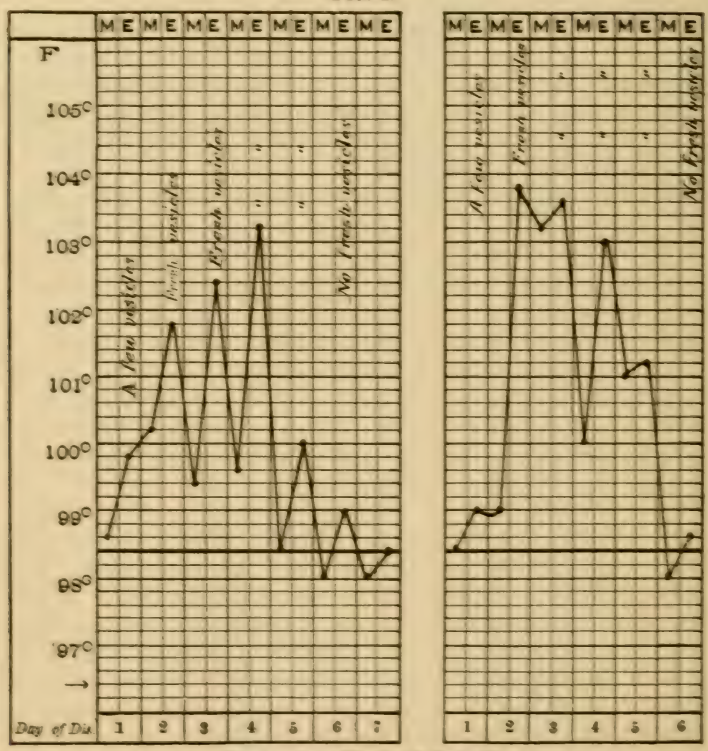
Symptoms.—At the close of the incubation the active period of the disease is often ushered in with a little chilliness, aching of head and limbs, diminution of appetite or complete anorexia, and perhaps nausea. With these symptoms there is usually moderate fever—from 99° to 102°. It often happens, however, that the eruption is the first symptom noticed, no complaint of illness having been previously made by the child. Only in rare instances are the phenomena of invasion alarming or even severe. Decided chills, fever of high grade, and even delirium, are occasionally met with at the onset, and in one case under the writer's care the disease was ushered in by two severe convulsions. Some authors allude to this very rare mode of beginning. But, whether these first symptoms of invasion are usually mild or entirely unnoticed or exceptionally severe, they are of short duration, and the eruptive stage is soon established. As it first appears, irregularly scattered over the body, the eruption consists of some small rose-red papules which very quickly

develop into vesicles. This change is effected so quickly that very often the papular stage is over and the vesicular stage is well under way before the eruption is discovered. The vesicles are seldom either numerous or large. Varying in number from a dozen or two to a hundred or more, they are scattered rather irregularly over the trunk, limbs, and scalp. They seldom make very much show on the face. Frequently a few are found on the forehead and temples when all other parts of the face are quite free. Often, if searched for, some blebs may be found upon the mucous membrane of the mouth and fauces. When seated thus on a mucous surface they quickly rupture and leave small ulcers.

The vesicles of chicken-pox are quite variable in size: some are not larger than pin-heads, while others reach the size of small peas. It was presumably the resemblance in average size to the "chick-pea," or "cicer," of Southern Europe that suggested to Dr. Morton the name of *chicken-pox*.

The tegumentary covering of the vesicle is very thin, being composed only of the outer layers of the skin. It contains an alkaline serum of crystal transparency, whence another admirable name for the affection, "*crystalli*," and the German "*Wasserpocken*." It was long ago aptly said that the rash of chicken-pox suggests an appearance as if scalding water had been flirted over the surface, each drop having raised a small transparent blister. Some of the vesicles

Fig. 1.



Temperature Charts of Varicella.

are surrounded by a narrow, often linear, and very pink areola; others rise abruptly from a surface of natural color.

A peculiar and distinguishing feature of chicken-pox is that the eruption

comes out in successive crops. Before, or as soon as, the first vesicles have arrived at their full size others are just beginning; and this may be repeated twice or thrice, or even four times.

The varicellar vesicles never become pustular like those of small-pox unless from scratching or other irritation, neither are they partitioned or umbilicated, as are those of variola. They are very rarely so numerous as to become confluent.

Another peculiarity of this disease is that, if the eruption is at all copious, many, perhaps most, of the vesicles abort and shrivel away before making much progress toward a completed development. I have observed that late vesicles are especially prone to abort. The other vesicles advance rapidly to maturity and enter on a speedy decline. Their fluid becomes opalescent and turbid, and dries down into a thin yellowish crust that soon crumbles and falls off, leaving a temporary redness of the skin. Now and then a few of the largest vesicles leave permanent cicatrices behind them.

During the eruptive stage the fever, which is almost uniformly intermittent in type, varies in degree with the acuteness of the attack and the extent of the eruption, mild cases, with only a few vesicles, being almost apyretic; severe cases, with a profuse eruption, being attended by a temperature of 104° or more. The usual range and duration of elevated temperature is illustrated in the charts on the preceding page (Fig. 1).

The whole course of chicken-pox seldom exceeds eight or nine days, or possibly ten or twelve at the most.

Diagnosis.—It is usually only to settle this important question that the physician is summoned. There can be no danger of confounding chicken-pox with any exanthem except variola. This mistake has frequently been made, sometimes with consequences deplorable to society and ruinous to professional reputation. The practitioner should therefore hold himself ready at all times to make a differential diagnosis of these affections.

The following are the chief points to be attended to:

Chicken-pox.	*Variola.*
Only infants and young children affected.	All ages affected.
Invasion short; general symptoms usually very light.	Invasion three days; general symptoms severe.
Eruption vesicular almost from first.	Eruption; papular stage prolonged.
Eruption superficial; never shotty.	Eruption deep-seated; hard, shotty.
Seldom umbilicated.	Generally umbilicated.
Vesicles not partitioned, multilocular.	Vesicles generally partitioned.
Vesicles always discrete.	Eruption often confluent.
Eruption little on face, hands, and feet.	Eruption most on face, hands, and feet.
No pustular stage.	Pustular stage never absent.
Uninfluenced by vaccination or previous small-pox.	Prevented by vaccination or previous small-pox.

Prognosis.—The outlook for chicken-pox is always favorable. There is no other disease that is so uniformly mild in its course and happy in its ending. There are no complications and no sequelæ for the physician to guard against. Few and far-between cases are reported—mostly from Europe—in which the vesicles become large, ill-smelling, and sloughing—varicella gangrenosa.

Sequelæ.—It is possible to find in medical periodical literature cases reported in which an anæmic, or even tuberculous, condition has followed so closely upon chicken-pox as to suggest the relation of cause and effect; but such instances are so very rare that we hazard little in predicting timely and complete recovery for all cases of varicella.

Treatment.—A disease whose course and duration are fixed, and whose ending is almost always favorable, requires little aid from medicine. Beyond

such care as to diet and exposure as will suggest itself to any sensible physician, nurse, or mother, nothing is needed.

The child should be taken from school, and should not be allowed to return until after full recovery and a thorough cleansing of the body and change of clothing. All this is necessary as a protection to others. In the rare event of the gangrenous form of this disease, the importance of good ventilation, antiseptics, and plentiful stimulation must not be overlooked. If convalescence should be protracted and the child exhibit evidences of anæmia or the graver condition of tubercular disease, iron and cod-liver oil, nourishing diet, with perhaps a change of air or a short sojourn at the seaside, will be a proper addition to the treatment.

VARIOLA AND VARIOLOID.

By C. G. JENNINGS, M. D.,

Detroit.

Variola, or small-pox, is an acute, specific, highly infectious disease, characterized by a typical range of temperature and a specific inflammation of the skin appearing usually on the third day of the disease as a papular eruption, which quickly becomes vesicular and finally pustular. The pustules desiccate, and leave permanent cicatrices wherever suppuration has invaded the deep tissue of the skin.

Etiology.—The nature of the contagium of variola is unknown; analogy, however, points to a micro-organism as the infectious principle. There is no evidence of the development of the disease *de novo*, each case being transmitted from a parent case in another individual. Individuals of both sexes and of all ages, unprotected by vaccination, are subject to the disease. Even the fœtus in utero does not enjoy immunity.

The disease is transmitted by direct contact, through the medium of infected articles and through the air. While scarlatina, measles, and other exanthemata will infect at the distance of only a few feet, small-pox has a striking distance that is very much greater. In the Sheffield epidemic (1887) the influence of the Sheffield hospital could be traced over an area having a radius of four thousand feet.

One attack, as a rule, renders an individual immune. In countries where the disease is prevalent a second attack is not uncommon. The writer saw a negro woman, ill with discrete variola, who was sadly disfigured by two previous attacks. The disease prevails most extensively among unvaccinated communities. The negro race is particularly susceptible. The disease is most infective during the periods of suppuration and desiccation. Although apparently independent of climate, small-pox is a disease of the winter and spring.

Pathological Anatomy.—The characteristic anatomical lesion of variola is found in the skin and mucous membranes. Small areas of congestion appear in the skin. The vessels of the corium dilate and become tortuous, and the connective tissue in the centre of the congested areas is thickened by œdema. Coagulation necrosis of the epithelial cells quickly follows, with thickening of the epidermis. These changes form the papules. Serum is poured out between the necrotic cells, and a vesicle forms. The changed cells form a meshwork in which the fluid is enclosed. Trabeculæ bind down the centre of the vesicle, while its periphery continues to distend, producing umbilication. Pus-cells form rapidly in the vesicle, and in a few hours it is transformed into a pustule. Inflammatory injection and thickening of the connective tissue surrounding the pustule now take place. If the necrotic process is confined to the superficial layers of the skin, resolution takes place without pitting. If the deep tissue is involved, a cicatrix results. Desiccation of the pustule follows, leaving a crust of dried cell-débris and pus adhering to the skin. Then the epidermis re-

forms under the crusts, the inflammatory injection and infiltration subside, the crusts drop off, and resolution is complete.

The process in the mucous membrane is the same. Perfect pustules, however, are rarely seen, because the macerated roof yields early to the pressure, and an aphthous-looking ulcer results, often covered by a pseudo-membrane. In hæmorrhagic small-pox the pustules contain blood, and extravasations may occur in the skin and mucous membranes at any point, and in the substance of all the organs. More or less intense congestion and septic inflammation may be found in the brain, liver, lungs, kidneys, and spleen.

Incubation.—The duration of the period of incubation of variola is, on the average, twelve days. Exceptionally it may be shortened to ten or lengthened to fifteen days. When transmitted by inoculation the disease appears on the eighth day or sooner. During the period of incubation the child, as a rule, shows no symptoms.

Symptoms.—The clinical history of small-pox may be divided into four stages: Invasion; eruption; secondary fever; desiccation or decline.

The stage of invasion is ushered in abruptly. Older children complain first of chilliness, and often there is a distinct rigor. The phenomena of severe fever quickly follow. In addition to the usual symptoms of fever there are headache of unusual severity, persistent vomiting, great prostration, and severe backache. In younger children and infants the disease begins with fever, great nervous irritability, and vomiting. Very often convulsions mark the onset of the disease. They may be frequently repeated, with intervals of stupor or delirium. The skin is dry or perspiring; the tongue coated, with dark-red edges. The bowels may be constipated, but often a sharp diarrhœa is present during the whole of the invasion stage. Abdominal pain and tenderness are frequent. Respiration is rapid. The pulse is full and quick, ranging from 120 to 160. The temperature quickly reaches a high point, ranging from 102° to 105° F., or higher. The high temperature is maintained during the invasion stage with but slight remissions. The maximum temperature of this stage is usually reached just before the appearance of the eruption. Partial paraplegia, numbness, and incontinence of urine and fæces, are sometimes seen in children.

In children more frequently than in adults *initial* or *accidental rashes* appear about the second day, and cause much difficulty in diagnosis. The initial rash may be erythematous, simulating scarlatina or erysipelas; or macular, simulating measles. It is very evanescent, and usually ushers in an attack of varioloid. A number of observers have noted that the areas of skin affected by the prodromal rash escape the variolous eruption. Petechiæ from one-twelfth to one-fourth of an inch in diameter are sometimes seen in this stage of the disease scattered over the lateral thoracic and lower abdominal regions. This rash is often of grave prognostic significance.

The average duration of the stage of invasion is three days. In grave cases it is often shortened to two, while in varioloid it is often prolonged to four days. As a rule, the longer the incubation stage the milder will be the subsequent course of the disease. Notable exceptions to this rule are the delayed rashes of cases complicated by severe internal diseases, and, as Moore observes, of cases showing an early hæmorrhagic tendency.

The Stage of Eruption.—On the third day of the disease, with the variations noted above, the true rash of small-pox begins. The eruption shows first on the face, quickly extending to the scalp and neck. Exceptionally it covers the wrists early. After the face and neck, it next invades the trunk, extremities, and finally the palmar and plantar surfaces, taking from twenty-four to

forty-eight hours to cover the cutaneous surface. Rarely, in very young infants, the rash appears first about the lower part of the abdomen and on the inside of the thighs. Other exceptions to the usual sequence are sometimes met. The rash is most abundant on the face and on the back of the hands. It shows early and abundantly on irritated areas of skin.

The eruption begins as small, slightly raised, pale-red macules, and passes through four stages of development—viz. *macules*, *papules*, *vesicles*, and *pustules*. The macules in a few hours become fine, conical papules, pin-head in size and larger. The papular stage continues for two days. The well-developed papules are hard and shotty to the sense of touch, "feeling like grains of shot underneath the skin." Gradual augmentation in the size of the papules takes place. On the third day a minute vesicle appears at the apex of the older papules; it rapidly grows, and transforms the papule into an umbilicated vesicle with cloudy contents. By the fifth day of the rash the fluid in the vesicles becomes turbid, and by the sixth day it is distinctly purulent. The eruption has now reached the pustule stage, or *stage of maturation*. The mature pock is globular and about the size of a pea. The increase of the contents has distended the chamber and removed the umbilication. The pustule is, in fact, a small abscess. It is usually surrounded by a swollen, red, inflammatory zone, the *halo* of the pustule.

Synchronous with the development of the cutaneous eruption a true variolous exanthem appears upon the mucous membranes. The visible mucous membranes are nearly always affected, and, in severe cases, the rash extends throughout the whole alimentary and respiratory tracts. The urethra, vagina, and conjunctivæ are often invaded.

With the appearance of the eruption a remarkable amelioration in all the symptoms takes place. The temperature rapidly falls, often reaching the normal point or a little above on the fifth or sixth day. This fall of the temperature is pathognomonic of the disease. The pulse loses its rapidity and the gastric and intestinal irritability subsides. In cases of severity the remission is less marked, and the severe symptoms of the incubation stage persist with but little relief. In discrete small-pox convalescence often sets in after three or four days of the mild febrile movement which follows the sharp decline of the beginning of the eruptive period.

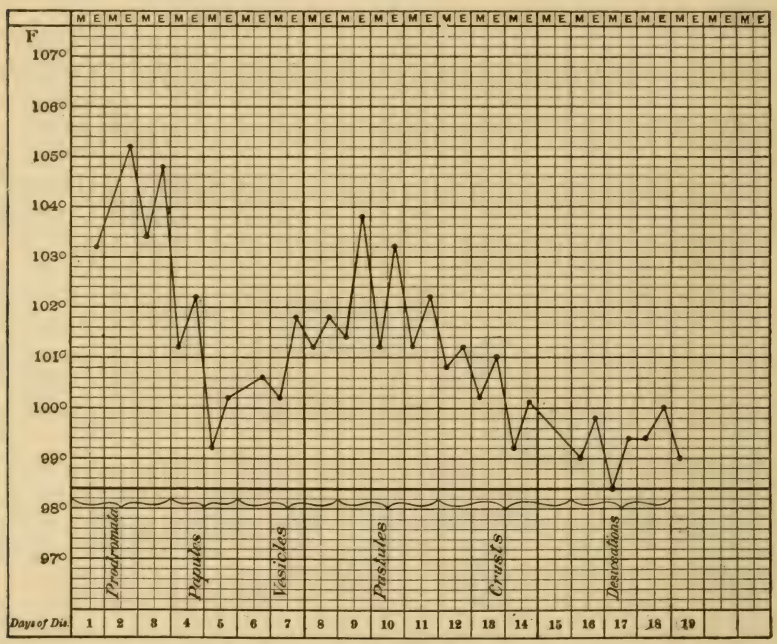
In children, with the beginning of the vesicular stage the eruption in the mouth and throat becomes a source of distress and danger. The vesicles rupture, and a streptococcus pseudo-membrane covers the resulting erosions and often extends over a large area of mucous membrane. Nasal and pharyngeal obstruction results, with distressing symptoms, and if the larynx be invaded, croup with dangerous stenosis may supervene.

In typical variola the maturation of the rash is accompanied by the onset of the *secondary fever* or *fever of suppuration*, which is of indefinite duration and varies in intensity with the severity of the attack. The child becomes restless and there is mild or active delirium. The temperature ranges from 101° to 104° F., with morning remissions and evening exacerbations. The pulse is quick and hard. Often the symptoms assume the typhoid type, with low delirium or stupor, a rapid, feeble pulse, and subsultus tendinum. A temperature that frequently rises above 104° during the stage of suppuration is of grave significance. (See Fig. 1).

The stage of desiccation or *decline* begins on the twelfth or thirteenth day of the disease. The pustules begin to dry up, the inflammation and swelling of the skin subside, the temperature gradually falls, and there is a general improvement in all the symptoms. Many of the pustules rupture and the

exuded contents form discrete or coalesced crusts. Cicatrization goes on underneath the crusts, and they finally drop off, leaving dark, violaceous blotches that

FIG. 1.



Temperature Chart of Variola of Moderate Severity.

are gradually changed to white, irregular, depressed cicatrices. The whole course of the disease occupies from three to five weeks.

Based upon the distribution and amount of the rash, variola is classified into—

(1) *Discrete variola*, in which the rash is scanty and the individual lesions are more or less separated from one another by healthy skin. The disease is rarely dangerous to life, its symptoms are mild, and its course is often interrupted before the development of the pustular stage. The secondary fever is absent or of short duration.

(2) *Confluent variola*, which is marked by an eruption that covers almost the entire cutaneous surface and invades the mucous membranes with great severity. The pustules upon the hands and face "run together, so that the epidermis is raised by a milky, sero-purulent secretion;" on other parts of the body the eruption is more or less discrete. The invasion stage is severe, and the rash appears as early as the second day. Severe vomiting and diarrhœa, stomatitis, salivation, pseudo-diphtheria, great and painful swelling of the face, hands, and feet, pyæmic abscesses, high fever, violent delirium, and great prostration are marked features of this type of the disease. The mortality is great, and convalescence is very slow and often interrupted by serious sequelæ.

In addition to these chief varieties we recognize—

(3) *Hæmorrhagic variola*, a malignant form of the disease, characterized by profound alterations of the blood, leading to the formation of petechial blotches and ecchymoses and more or less profuse hæmorrhages from the mucous membranes.

(4) *Varioloid* is variola modified in its course, duration, or intensity by vaccination, previous attacks of variola, or inherited insusceptibility. The invasion stage of varioloid is more irregular in duration than that of unmodified variola, and the symptoms may be so mild as to escape observation, or so intense as to simulate the onset of grave variola. Three types of variation in the clinical history of varioloid may be distinguished: (*a*) After an invasion stage of the severity of typical variola a copious eruption appears. With the appearance of the rash, however, a rapid defervescence begins, and the eruption is aborted in the papular or the vesicular stage. If it go on to the pustular stage, the pustules quickly run their course without causing much discomfort to the patient, and leave only faint cicatrices or none at all. Or, (*b*) the disease runs a course typical in all respects, but the pustules are few in number and the accompanying symptoms very mild. Again, (*c*) the symptoms of invasion are well marked. A trifling eruption of maculo-papules appears and quickly fades. Instead of rapidly convalescing, however, the patient shows a period of anæmia and mental and physical prostration out of all proportion to the preceding symptoms.

Complications and Sequelæ.—The complications of variola are few in number. Streptococcus invasion of the subcutaneous connective tissue may give rise to multiple abscesses, phlegmonous erysipelas, boils, and, rarely, in scrofulous children, to gangrene; the deeper structures, the joints, and the viscera may also be invaded. In children the most frequent complications are inflammations of the mucous membranes. Pseudo-diphtheria of the pharynx, nose, and larynx is frequent in severe variola; rarely the membrane invades the bronchi. Bronchitis and broncho-pneumonia, pleuritis with resulting empyema, purulent otitis media, and pericarditis or endocarditis often occur. Conjunctivitis is present in all bad cases; sometimes the inflammation is very severe, and results in ulceration of the cornea and destruction of the eye. Enterocolitis is often the cause of death in infants.

Diagnosis.—Typical variola in the eruptive stage presents no difficulty of diagnosis. Mild and atypical cases, however, are often very perplexing. The invasion stage may be mistaken for a continued fever or pneumonia. The sharp pain in the back, the vomiting, and the marked nervous symptoms should put the physician on his guard. The initial erythematous rash, coming on the second day, and the vomiting, are very like scarlatina. The small, often irregular, and very rapid pulse, the peculiar tongue, and the pharyngitis are distinctive of scarlatina. The rash of scarlatina, again, has a different initial distribution; it first appears on the face, neck, and front of the chest.

An initial macular rash, or the papular stage of variola, may simulate measles. In measles the gradual onset of the invasion stage, the tendency to sleep, the catarrh of the conjunctival and respiratory mucous membranes, the absence of the backache, severe headache, and vomiting, are distinguishing features. With the appearance of the rash in measles the fever and all the other symptoms *increase;* in variola they *decrease.* The "grisolle sign" is a certain means of distinguishing the papules of variola from the macules of measles: "If upon stretching an affected portion of the skin the papule becomes unpalpable to the touch, the eruption is caused by measles; if, on the contrary, the papule is felt when the skin is drawn out, the eruption is the result of smallpox."

The differential diagnosis of variola and varicella sometimes presents great difficulty. Varicella is characterized by a short period of invasion, the eruption usually being the first indication of ill-health that the child manifests. The varicellous vesicle is located beneath the most superficial layers of the epi-

dermis. The macular stage of varicella is short, and the macule is soft and but slightly elevated above the surface. The vesicle does not become pustular, but remains filled with clear or opalescent fluid for twenty-four or forty-eight hours, and then dries into a light, easily-detached crust. The distribution of the vesicles, abundantly over the back and sparsely on the face and hands, is very characteristic of varicella. Occasionally only the greatest care will enable the physician to differentiate between these two diseases. No one symptom or manifestation can be relied upon, but all the points in the history and development of a given case must be carefully considered.

Prognosis.—The frequency of complications involving the mucous membranes in children, and their feeble powers of resistance make the prognosis of variola in early life very grave. According to Moore, the disease is most fatal in unvaccinated children under five years of age. The younger the child the graver the prognosis. "The influence of vaccination for good is unquestionable, the mortality being 50 per cent. among the unvaccinated in general, 20 per cent. among the badly vaccinated, and only $2\frac{3}{10}$ per cent. among the efficiently vaccinated" (Moore). Hæmorrhagic and confluent variola are very fatal. The complications that unfavorably influence the result are—pneumonia, empyema, multiple abscesses, septicæmia, pseudo-membranous laryngitis, and entero-colitis. Favorable cases present a mild or no secondary fever, and are not prolonged by complications.

Treatment.—There is no drug that will prevent the development of variola in an infected individual. The efficacy of vaccination in arresting or modifying the disease after exposure is a disputed question. Curschmann has no confidence in the measure. Welch, however, from an experience in 159 cases, believes it to be of great utility, and his results warrant the use of the measure in every person exposed to variola: "In order that protection shall be complete it is necessary that the insertion of the vaccine lymph should be made almost immediately after the reception of the contagion; but if made at a somewhat later date a modifying effect may be obtained. No part of the incubation period should be considered too late to make use of this remedy, since this period is sometimes prolonged beyond its usual limit, in which case a late vaccination may prove of value" (Welch).

A child ill with small-pox should be placed in a very well-ventilated room of a temperature of 65° to 70° F. The strictest attention should be paid through the whole course of the disease to the smallest details of the hygiene of the patient and the sick-room. If the attack be severe, the hair should be closely cut. The diet should be light and nutritious. Effervescent waters, milk and seltzer, sour wine, champagne or lemon-juice and apollinaris, Belfast ginger-ale, and egg-water form agreeable and nutritious drinks. During the period of invasion the febrile symptoms, vomiting, headache and backache, and the nervous phenomena may demand treatment. A gentle cathartic should be given at the onset of the disease. A febrifuge, like tincture of aconite, spirits of nitrous ether, or a solution of acetate of ammonium may be given in proper doses. Gastric irritability may be controlled by effervescing citrate of potassium, chloroform-water, or subnitrate of bismuth. Chloroform-water and morphine are very useful, combined as follows:

℞. Morphinæ sulphatis . . . . . gr. $\frac{1}{8}$.
Aq. chloroformi . . . . . f℥ij.—M.
Sig. A teaspoonful may be given every half hour to a child of five years.

Insomnia or convulsions demand the administration of chloral or bromide

of potassium. Baths, temperature 95° F., are most useful to control the fever and nervous symptoms, and they may be repeated every four, six, or eight hours as may be necessary. One of the coal-tar antipyretics may be given. They have a remarkable power to control the pain, nervous symptoms, and fever at the onset of an acute disease. Given in proper doses and in selected cases, their effect is only for good. Applications that irritate and redden the skin are to be avoided. An ice-bag or a cold-water coil to the head lowers temperature and relieves cerebral symptoms.

During the eruptive stage, after the development of the secondary fever, the same conditions for internal treatment are met. The fever is to be controlled, preferably by the bath, made lukewarm or cool as the season and the condition of the patient dictate. Cool sponging, cool compresses, or the wet-sheet may replace the tub. The coal-tar antipyretics are to be given with caution. Delirium and convulsions are to be met by bromide of potassium, chloral, or the bath; insomnia, by these remedies or sulphonal. When there is intestinal irritability, chloranodyne is an admirable sedative. Quinine and the tincture of chloride of iron in full doses have the confidence of able practitioners as being useful to combat septic symptoms. Variola with mild secondary fever will not usually demand alcoholic stimulants. In grave cases moderate stimulation should be begun early, and as the strength wanes under the influence of continued septic absorption the alcohol should be pushed to the full limit. A child of five years will take from two to four ounces of whiskey or its equivalent in the twenty-four hours, sometimes more.

The nose, naso-pharynx, and throat should receive strict attention to relieve inflammation and avoid septic absorption. Irrigation of the pharynx with solution of potassium chlorate, boric acid, or witch-hazel should be begun early. The writer finds a solution of listerine and hydrogen peroxide one of the most satisfactory local remedies for pseudo-membranous and septic conditions of the mouth and throat, for example:

Solution of hydrogen peroxide(15 vol.),	
Listerine	each 1 part.
Water	6 parts.

This solution should be thrown into the pharynx with an all-soft rubber syringe, until thoroughly cleansed, every one, two, or three hours. This is the most satisfactory way to cleanse a child's throat. The same solution, with double the quantity of water, may be used in the nose with the same syringe. When such thorough cleansing is not demanded, the spray from an atomizer will serve, but it should not be trusted in severe cases.

To limit the development of the pustules and to prevent septic absorption and pitting a great number of methods of local treatment have been proposed. Secondary streptococcus-infection of the pustules without doubt plays an important part in the cutaneous destruction, septic absorption, and deep pus-formations; careful cutaneous disinfection during the papular and vesicular stages of the eruption will tend to limit this secondary infection. The skin should be bathed twice a day with soap and water, and this followed by sponging with a boric-acid solution 1:20, diluted listerine, or corrosive sublimate 1:2000. Omitting the soap, the baths, varied to suit the condition, may be continued during the whole course of the disease. Carbolic acid is an excellent antiseptic and cutaneous analgesic. It is one of the most efficient remedies for the relief of the itching and burning that accompany the development of the rash. Compresses of antiseptic gauze, wet with a hot or cold

solution, 1 : 500, may be kept constantly applied to the skin. Carbolic acid may also be used in solution with glycerin or in an ointment. An ointment of 4 parts of salicylate of sodium and 100 parts of cold cream is commended. Antiseptics may also be used as a spray or in the form of a powder, as subnitrate of bismuth, boric acid, or a compound of aristol 20 parts, talc 100 parts. Powders are most useful in the late stages of the eruption. Early opening of the pustules is a measure advocated by many writers. It seems rational thus to treat the pustules as small abscesses—to open them early, at least upon the hands and face, and treat them antiseptically. A wet compress of antiseptic gauze applied after evacuation and thorough cleansing with a three-volume solution of hydrogen peroxide would certainly prevent additional destruction of the corium from pus-microbe invasion.

In the stage of decline iron, quinine, and strychnine, highly nutritious food, and moderate stimulation are demanded. Convalescence is often slow and interrupted by complications. Arsenic, cod-liver oil, malt, iron, liquors, and supporting treatment generally are necessary. The various complications and sequels should receive the most approved medical and surgical treatment.

Quarantine.—A child with small-pox should be immediately isolated, and a rigid quarantine maintained until the skin is free from crusts and complicating suppurations have healed—a period of from five to six weeks. Confinement in a contagious diseases hospital gives most certain protection to a community, although perfect isolation can be maintained in a private house. For this purpose the highest, best-aired, and most remote room should be selected, opening indirectly, if possible, to the rest of the house. Sheets wet with an antiseptic solution should be kept hung over the doorway. All direct communication of the nurse and patient with other members of the family should be interdicted. Clothing, dishes, excreta, etc. should be disinfected before being taken from the room. All members of the infected household should cease direct communication with the outside world, and all exposed individuals should be quarantined for a period of fourteen days after exposure.

VACCINIA; VACCINATION.

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Vaccinia, or cow-pox, is a contagious eruptive disease of the cow, characterized by a more or less profuse eruption, upon the udder and teats, of papules which develop into vesicles, and these, by drying, into crusts, or, through rupture, into open ulcers. By inoculation of lymph from its vesicle the disease is communicable to man, and is capable of conferring upon him immunity from small-pox more or less complete and lasting.

History.—In the closing years of the eighteenth century, among all the civilized nations of Europe and their colonies, the practice of inoculating for small-pox had become the accepted therapeutic procedure for modifying the ravages of this then most familiar and loathsome of diseases. The operation was not, however, always successful in producing mild cases of the disease, and even in its most favorable manifestation the communicated affection was still variola, capable of being transmitted to others by effluvium, and necessitating careful isolation, nursing, and medical treatment. So common was small-pox that, according to the philosophy of the times, every individual had either passed through, or was destined some time to experience, an attack of the disease. In 1776, Edward Jenner, an English country practitioner living at Berkeley in Gloucestershire, was first attracted by a popular belief, common among the dairy-hands of this county, that any one who had contracted cow-pox from milking cows affected with this disease was insusceptible to small-pox, and was not a successful subject for variolous inoculation. This tradition seems to have been quite well known among the dairy-hands of Gloucestershire and the neighboring counties, and to have been noted by other practitioners throughout the farming country. Intentional inoculation of cow-pox had even been performed before Jenner's attention was directed to the matter: Robert Fooks, a butcher of Bridport, as related by Pearson, had submitted to the inoculation by means of a charged needle, as early as 1771, and Benjamin Jesty, a farmer of Yetminster in Dorset, in 1774 inoculated his wife and two sons with the cow-pox as a preventive of small-pox. But it was not until the subject received the careful study and experimentation of Jenner, culminating in his celebrated *Inquiry*, published in 1798, that the practice of inoculating cow-pox was established upon a clinical and what, at least for the times, must be called a scientific basis. The story of Jenner's struggles to convince his contemporaries of the value of his observations forms a most interesting and instructive chapter in the history of medical progress. The discovery spread with wonderful rapidity throughout the civilized world, and it stands to-day as one of the greatest blessings that human thought and observation have conferred upon mankind.

Etiology.—"Spontaneous" cow-pox, the term ordinarily though not very accurately applied to cases of vaccinia occurring naturally in the cow, is an

occasional disease among dairy herds. It is spread by contact, being usually carried from one animal to another by the hands of the milkers, who in this way are themselves liable to accidental inoculation. For this reason the affection is almost exclusively confined to milch-cows, and the eruption limited to the udder or teats, although young calves or adult bulls may be readily inoculated upon the belly, and exhibit phenomena differing in no way from those observed in the cow.

The exact nature of vaccinal disease is a question which has been the subject of repeated theorizing and experimentation since the time of Jenner, and even at the present day no consensus of opinion has been reached. Jenner held that cow-pox was occasioned by the accidental conveyance of the virus of "grease," an eruptive disease of the heels of the horse, to which also he attributed, on conjectural grounds merely, the origin of human small-pox. According to his view, a vaccinated person was a small-poxed person who, instead of suffering from the humanized and virulent form of the disease, had contracted it in its primitive mild character. This theory, at least in regard to its ingenious attempt at the etiological unification of cow-pox and small-pox, can be dismissed as a curiosity of medical history.

A second theory considers vaccinia as a distinct disease of the cow originating in a specific contagium, and being in no way related to or capable of being originated by any other contagium, however closely its phenomena may be simulated. It is evident that its rejection or its acceptance is to be based upon the proof or refutation of other theories, and thus it can be more readily discussed side by side with the third and remaining theory.

This theory, which offers in many respects the most rational view of the question, regards cow-pox as small-pox modified and attenuated by passing through the system of the cow. There can be no doubt that variola can be artificially communicated to the cow, and can give rise to a vesicular eruption resembling in all physical respects the lesions of spontaneous cow-pox, and that virus from these vesicles can be conveyed to man, and produce at the points of inoculation local effects in all appearance identical with those produced by cultivated vaccine-lymph. Experiments of this kind are now quite numerously recorded, among which may be mentioned the successful variolations of the cow performed by Gassner in 1801, and after him those of Thiele of Kasan, Ceely of Aylesbury, Badcock of Brighton, Martin of Attleboro, Mass., Voit, Reiter, and many others. In some cases the virus thus obtained, when used for experimental inoculation upon human subjects, especially in the early removes, showed undoubted evidence of being variolous by giving origin through infection to fresh cases of small-pox some of which were fatal. Martin's variola-lymph produced quite an epidemic of small-pox in Attleboro, Massachusetts, in 1836, and Reiter's experiments in Munich in 1839 had a similar sequel. It is certain, however, that if in the selection of a variolous virus the same care be exercised as was habitual with experienced small-pox inoculators like Sutton and Dimsdale, a variolation of the cow may be effected which will give origin to a lymph that need not necessarily convey infection to those not inoculated. This was shown in the experience with Badcock's variola-lymph; and, as Crookshank remarks, identical results were obtained by Adams in many cases where lymph from a mild or "pearl" case of small-pox was taken as a primary virus for successive arm-to-arm inoculations, without having been first passed through the cow.

This whole subject was carefully investigated in 1865 by the Lyons Commission under the direction of Chauveau, who, even in 1891, still showed himself the most distinguished champion of the dual nature of the two diseases.

The result of the investigation of this committee unequivocally pronounced upon the autonomy of cow-pox and the impossibility of converting small-pox into cow-pox. A more recent investigation of the question by Fleming, a well-known English veterinarian, confirmed the conclusions of the Lyons Commission. The question is not, however, by any means settled. Even as recently as 1892, Hime of England and Haccius and Éternod of Switzerland, published careful studies in support of the older view, and, excepting in France and America, the theory of the identity of the two diseases seems to be gaining ground.

To complete the subject it may be stated that several years ago Depaul of Paris established the fact that horse-pox, a febrile eruptive disease of the horse, was capable of being conveyed by inoculation to the cow, and giving rise to a lesion indistinguishable from that of cow-pox. Constantin Paul, indeed, for a time used such virus for vaccination, but the practice fell into disuse after the discovery of a case of spontaneous vaccinia at Beaugency.

Pathological Anatomy.—The structure of the vaccine pock resembles that of variola (Cornil and Ranvier). It is formed by the softening and liquefaction of the epidermic cells, which appears to be caused by the micro-organisms which early occupy the centre of the pustule. There is a central necrotic zone, a middle zone characterized by tumefaction of the cells, and a peripheral zone of irritation showing multiplication of nuclei (Pincus). The cavity of the pock is partitioned or multiloculated, and its base, thickened and infiltrated with lymph, constitutes the "vaccinal pulp." The derm is always infiltrated with leucocytes. The lymph is a clear, transparent liquid up to the fifth day in the cow and till the seventh or eighth in man; it maintains its infective qualities at a low temperature, but loses them quickly in warmth. Histologically, it contains leucocytes, red globules (after the eighth day), granulations and cellular débris, free nuclei, and micro-organisms.

Keber in 1868, and subsequently Chauveau and Burdon-Sanderson, observed the existence in lymph of minute rounded organisms to which the terms vaccinads or microspheres have been applied. Keber attributed to them the specific properties of the lymph. More recently (1890) the experiments of Straus, Chambon, and Ménard have shown that lymph from which these bodies had been removed by filtration loses its infective power, even when injected in quantity beneath the skin, so that it may be concluded that these micro-organisms are the agents of infection. No distinct microbe, however, has as yet been satisfactorily isolated. In 1883, Quist cultivated upon alkaline serum a coccus, which, when inoculated upon a child, rendered it refractory to subsequent vaccination. Voigt (1885) isolated three micro-organisms, of which one, a coccus, was found capable of causing typical experimental cow-pox in the calf, from which the same organism was again obtained. Garré (1887) confirmed the results of Voigt, cultivating a coccus which existed in a pure state under the derm subjacent to the pustule, and which caused cow-pox in the calf, but not in man until after passage through the calf.

Varieties of Lymph.—Practically, there are two sources from which vaccine-lymph may be obtained—either directly from the bovine through the agency of vaccine farms especially established for its propagation, or indirectly therefrom after passage through the system of one or more human beings, the healthy infant being the medium usually chosen. Lymph from the so-called cases of spontaneous cow-pox is very rarely to be had, and is said to be untrustworthy in its infective powers; while variola-vaccine must still be considered as of experimental value merely, and not to be ordinarily employed. At the present day it may be said that in no essential respect is humanized virus to

be preferred to animal lymph, if we except its slightly greater promptness of action, which may, however, have some value in time of epidemics. The possibility of the transmission of syphilis through humanized lymph derived from a syphilitic patient, while exceedingly rare, is still a constant danger, and pleads strongly against the use of any humanized virus except from an unimpeachable source. In selecting lymph, either from the calf or from the human vaccinifer, a characteristic vesicle from the fifth to the seventh day should be chosen.

Symptoms.—When carefully selected and cultivated vaccine-lymph is introduced by inoculation into the human system, the following phenomena will be normally observed: At or close to the site of inoculation at the end of the second or beginning of the third day a slight papular elevation is observed; by the fifth or sixth day this has become a distinct vesicle, of bluish-white color, with rounded elevated edges and a cupped central depression—the so-called umbilication. By the eighth day the vesicle is perfected, and is then circular, pearly in color, and distended with a colorless lymph, the central depression remaining well marked. On or about this day appears the areola, a reddish blush of the skin surrounding the pock to a distance of several inches, and accompanied by induration and swelling of the underlying connective tissue. After the tenth day the areola begins to fade, the vesicular contents begin to dry in the centre, the process extending to the surrounding lymph, which becomes opaque and gradually desiccates, until by the fifteenth day a hard brownish thick scab is formed, which is gradually detached and falls in the fourth week. A circular, depressed, pitted, or sometimes radiated cicatrix remains. If there have been several points of inoculation close together, a compound vesicle of irregular shape may result. Even with a single surface of inoculation one or more additional vesicles may arise at some little distance from this point.

Constitutional symptoms are almost always notable to some degree in a case of primary vaccination. The temperature may rise one or two degrees on the third or fourth day, and remain elevated for several days. In children restlessness, irritability, and loss of appetite may frequently be noticed. The axillary glands or the inguinal glands, depending upon the choice of the arm or leg for operation, will usually show some swelling and tenderness for several days. In many cases, mostly those of secondary vaccination, the constitutional symptoms are more severe; the fever higher, with transient delirium; nausea or perhaps vomiting; and distressing headache. Itching of the skin round about the pock is commonly experienced, perhaps throughout the whole course of the case, and this may be so severe as to constitute a true pruritus.

Irregularities in the Course.—Various irregular manifestations of the pock have been described by earlier writers, but in later years, since the more general employment of animal lymph, these irregular forms have become much rarer. One peculiar abortive form, the raspberry excrescence, should be mentioned. Here the pock is rather slow in appearing, and never reaches full development, but becomes a flat, hard, reddish papule, resembling a nævus, and finally, after weeks or months, disappears without cicatrix. It is probably an abortive form, and does not protect against small-pox or subsequent vaccination.

Another irregularity is the so-called eruptive vaccinia, in which there is a generalized eruption of pocks, the disease manifesting itself as a true exanthem. Very rarely cases have been observed in which the susceptibility of the skin was so great that repeated accidental auto-inoculations took place from the merest scratches of the nails.

Complications.—*Inflammatory phenomena*, due to traumatism, irritation, infection, or special conditions of the system predisposing to cutaneous disease, are at times manifest. These may vary from a simple erythema to intense phlegmonous inflammation or ulceration and gangrene, with septic absorption. Injury to the pock before complete maturation may be followed by a gangrenous condition of the underlying derm, sometimes giving rise to a peculiar moat-like depression around a central elevated core. Mothers are very prone to attribute any irregularities or unusual violence in the maturation of the pock to "bad virus." Occasionally, especially when human crusts have been used, this may be a just charge; but it can be authoritatively stated that complications arising from impurities of the lymph will almost invariably show their presence long before the pock has reached its full development, usually within a few days after the operation.

Erysipelas is very prone to infect vaccination wounds. It may appear as early as the second or third day, and in this case the prognosis is especially grave. Vaccination should never be performed when erysipelas is prevalent, except in face of the greater danger of variola.

Glandular Enlargement.—The natural involvement of the axillary and cervical glands, usually insignificant, may in certain subjects become extreme, and even go on to suppuration during maturation or toward the decline. In children of strumous habit vaccination may act as the exciting cause of chronic enlargement and cheesy degeneration of glands in these chains.

Abscess and boils may follow in various parts of the body, especially in children of tubercular tendency.

Eczema and other skin affections are apt to be aggravated or relighted by vaccination. Various roseolous rashes may be observed during the maturation of the pock, and are only important as requiring differential diagnosis from intercurrent and perhaps more serious affections, such as erysipelas, scarlatina, and rubella. Impetigo contagiosa has been observed not infrequently, and seems to bear some relation to vaccinia, which is as yet not clearly understood.

Syphilis.—Chiefly to Viennois in France and Hutchinson in England are we indebted for the demonstration that syphilis may be communicated by humanized virus through contamination with the patient's blood, which, as Ricord has shown, is always present in the lymph. Accidental conveyance of the disease by imperfectly cleansed instruments used for vaccinating is also to be mentioned.

The treatment of complications will not differ from that to be employed in the conditions occurring independently of the vaccinal disease.

Method of Operation.—Inoculation can be accomplished in numerous ways. Some practitioners advocate a series of superficial cross-bar incisions made with a sharply-pointed lancet or the back of the point of an ordinary bistoury; others employ a sharply-pointed rake-like instrument made for the purpose, while tattooing with a sharp needle point has been advocated. Altogether the most satisfactory method of preparing the spot for vaccination, and one which robs the little operation of its terror to children and mothers, consists in gently scraping away the external horny layer of epidermis with the edge of a bistoury or lancet held obliquely to the surface. For this purpose a dull instrument is sometimes advocated, but a sharp edge is more effectual and expeditious. An area as large as the little finger-nail can be readily abraded in this manner without giving rise to a whimper on the part of the child. The abraded surface should be slightly red and glazed by the outpouring of lymph, but no blood should be drawn. The next step is the inoculation of the lymph. In arm-to-arm vaccination the lymph is directly transferred from the pock to

the abraded surface. When the dried animal virus is used, it should be liquefied by dipping into cold sterilized water just before the surface is prepared, so that in the brief interval it may become completely softened.

Any portion of the cutaneous surface may be chosen for the insertion, but customarily the outer aspect of the left arm over the insertion of the deltoid is selected. For cosmetic reasons in girls the leg is often preferred, and in this case a point over the head of the fibula or over the junction of the two heads of the gastrocnemius is the usual choice. The primary vaccination of the infant may be undertaken at any time. In the face of an epidemic the new-born babe should be vaccinated within twenty-four or forty-eight hours after birth, and, as the experience of Wolff has shown, in such cases humanized lymph is to be preferred as producing less constitutional disturbance. Ordinarily, however, the operation may be deferred until about the third month when the child is in good physical condition and before the disturbances of dentition have commenced.

Protective Power of Vaccination.—The experience of the past one hundred years offers the most just and conclusive evidence of the power of vaccination as a preventive of small-pox. From one of the commonest and most virulent of diseases small-pox has become in civilized countries one of the rarest of the exanthemata. A most significant fact in favor of vaccination is given by Gay in a study of small-pox in London. He states that in the last forty years of this century, owing to improved sanitation, epidemics of measles, scarlatina, diphtheria, and whooping-cough have all undergone a decrease, but that this is only a small fraction of that which has occurred in small-pox, their highest figures not amounting to a tenth part of the decrease of small-pox—a result which is dependent upon only one possible cause, vaccination. Drysdale states that during the epidemic in Berlin in 1872 and 1873 the mortality rose to 243 and 263 per 100,000; then, vaccination in the first year of life and revaccination in the twelfth being made compulsory, during the first year of enforcement (1875) the mortality fell to 3.6 per 100,000, to 3.1 in 1876, and to 0.3 in 1877.

The protective power is not absolute in all individuals, nor can the period of protection be stated for any given case. Marson, whose experience with small-pox in London was very extensive, stated that the disease was more fatal among those whose scars were imperfect or few in number than in those showing well-marked and multiple cicatrices. While some doubt of the value of this theory may be expressed, it would seem wisest to vaccinate in all cases by at least two insertions, sufficiently far apart to prevent coalescence during development of the pocks. As a general rule, it may be stated that immunity in the great majority of cases will be attained by revaccination every four or five years, and always when small-pox becomes epidemic. If absolute immunity from small-pox be not conferred, the course of the disease will be greatly modified and ameliorated. In some very rare instances vaccination and revaccination seem to offer no obstacle to the development of severe variolous disease. According to Biedert, after a successful vaccination immunity is secured in about eight days. Vaccination after infection with variola does not guard against the development of the disease, but if done eight days before the eruption appears the evolution will take place benignly.

PAROTITIS.

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By the term "parotitis" is to be understood an inflammation of the parotid gland. By the inelegant term *mumps* we usually understand an acute infectious disease, often epidemic in character, in which the parotid gland is always inflamed, other glands being also involved occasionally. If it were possible to dislodge the term "mumps" from the mind of the profession and the public, it would be in the line of progress, for, like many other terms which cling to medical nomenclature, it is inaccurate, inelegant, and would be inexpressive were it not for its arbitrary association with acute epidemic parotitis.

This affection is usually regarded as one of the diseases of childhood. It is unfortunately true that many mothers think it necessary that their children must experience this and several other infectious diseases at some period of their childhood, forgetful of the fact that disease is always to be avoided if possible. It is true that one attack of epidemic parotitis usually furnishes immunity from others of the same character, but until we are further advanced than at present in the science of preventive inoculation it will not be wise to encourage the acquirement of infectious disease from such a motive. Small-pox, and possibly hydrophobia and tetanus, furnish exceptions to this rule, and the day is probably dawning when the list can be lengthened.

Epidemic parotitis is not limited to the period of childhood. Many epidemics are recorded in which it prevailed exclusively among men. This is especially true of soldiers in garrisons and barracks. Two such epidemics are recorded by Girard in which the testicular complication was severe, and others by Gnasco, Dogny, Jourdan and Laurens. Males suffer with it more frequently than females.

But parotitis is not necessarily an infectious disease, for there is a form which is purely traumatic and limited to the parotid gland, and another which may be called an irritative form, in which malignant disease in or near the gland incidentally causes true inflammatory action with infiltration and induration. Of this form nothing further need be said in this connection, the consideration of the subject being limited (1) to its traumatic, (2) to its infectious, aspect.

Pathological Anatomy.—Writers upon pædiatrics have remarked the incompleteness of the knowledge of the anatomy of this subject. This is due to the small number of fatal cases, excepting those in which the disease has occurred as a complication, and in which, from gangrene or abscess, the gland-structure is more or less completely destroyed. Virchow studied the disease in 1858, and his work is fundamental with reference to anatomical knowledge at that period. The development of bacteriological science has modified all our knowledge concerning infectious disease and its effects. In general it may be said, with Ziegler, that the anatomical appearances are those which are due to inflammatory, serous, and cellular infiltration of the inter-

alveolar fibrous tissue of the glands, issuing either in resolution, fibroid induration, suppuration, or gangrene. Bamberger describes the gland as enlarged, red, swollen with exudate in the interstitial tissue, the acini fused together, and the cellular tissue of the entire gland involved. In severe cases the entire glandular substance is involved and converted into a fleshy dry tumor. The exudate may be absorbed, the gland resuming its normal size and consistency, or the exudate in the cellular tissue may become thickened and organized, leading either to permanent increase in size or to atrophy.

Etiology.—The two varieties or forms of the disease to be considered are: (1) the traumatic, (2) the infectious.

(1) *The traumatic variety* is the result of blows or bruises, with more or less effusion of blood into the gland and surrounding tissues. The inflammation and swelling may be extensive, especially in syphilitic or strumous subjects, the great sensitiveness of the glandular system of such individuals rendering them peculiarly liable to disease of this character even when the injuries received have only been of moderate severity. It may also be the result of burns about the face and neck or of the application of irritating chemicals and caustics. This form of the disease is entirely distinct from the infectious, and illustrates the fact, which for some time was in dispute, that inflammatory conditions are quite possible without the influence of micro-organisms.

(2) *The infectious form* of the disease may be simple or immediate, symptomatic or metastatic. That parotitis may be a complication of so many other conditions is an argument against the proposition that it is always caused by a specific microbe. There is scarcely an infectious disease in which it may not so appear. It may complicate pneumonia, diphtheria, and typhoid fever, each of which has its specific cause; hence we are obliged to refer it to that very convenient class of diseases known as mixed infections, in which the limitations to one who is not a bacteriologist are as yet rather vague. It is quite proper to refer to the work which has been done with the view of placing its etiology upon a definite basis (*i. e.* from a bacteriological standpoint).

Pasteur found a bacterium in blood taken from patients with this disease, but inoculations of animals with cultures obtained from it were negative. Bordas described a bacillus found in the blood which he termed *bacillus parotidis*. In certain phases of its development it assumed an S or Y shape; when divided the ends became enlarged. It died at a temperature of 140° F., and its spores at 194° F. Its development was arrested in 1:500,000 solutions of mercuric bichloride. Cultures were made from the saliva of parotitic patients, and were rich in the microbe. The investigations of Capitan and Charrin in this field have been more extensive than others, and have to a great degree furnished a basis for other work. They first examined the blood, saliva, and urine from six cases. In the blood were found small, mobile microbes in great numbers, most of them being spherical, but some rod-shaped. Similar bodies were found in the saliva, while in the urine they detected neither albumin, sugar, nor microbes. In 1881, after a study of the blood in thirteen additional cases, they were able to confirm their previous discoveries. They particularly described a bacterium two to three thousandths of a millimetre long and also a small micrococcus, the microbes appearing singly, doubly, and in chains. Cultures of the microbes were successfully made, but inoculations of dogs, rabbits, and guinea-pigs were negative. These discoveries were verified by Védrènes, Bouchard, Netter, and Boinet, the latter finding the microbes in the blood of fifteen patients, also in pus from an abscess of the nucha. Ollivier found the microbes in saliva, urine, and blood from three subjects, and suggested that failure in the inoculation of animals was due to the insusceptibility to parotitis of all species of animals

upon which experiments had thus far been conducted. He believed that we could now see in parotitis not the simple effect of cold, or a manifestation of the rheumatic diathesis, or a propagation of a phlegmasia of the mouth, but an infectious disease caused by a specific agent and propagated by the diffusion of that agent. Jaccoud has expressed himself almost equally hopefully.

In the simple or immediate form, which is the usual one in most epidemics, the contamination of the atmosphere with the infectious elements, especially in schools or barracks, in which the air-supply is deficient, explains its dissemination. This statement harmonizes with the fact that it is most prevalent in damp and cold weather when the windows and doors of houses are closed and the tendency or the necessity is to remain in-doors. The elements of the disease are also carried from house to house in the clothes of physicians and visiting friends. This explains the prevalence of epidemics in sparsely-settled localities. Infection is probably acquired in respiration, and those who are mouth-breathers are the more susceptible. Whether the long period of incubation which follows the reception of the infective influence means retention of the elements in the ducts of the salivary glands or in the glands themselves, or whether there is a process of germination within the blood and localization in the glands, we do not know. The latter is the more reasonable hypothesis from the analogy with other infective germs which are known to develop in the blood. As in all other infectious diseases, the intensity is governed partly by the activity of the infectious elements and partly by the resistance of the individual.

In the secondary, metastatic, or symptomatic variety of infectious parotitis the inflammation is a complication of a pre-existing disorder. The list of diseases in which it may play such a rôle is a long one, including the infectious diseases in general, besides nephritis, pneumonia, meningitis, and surgical injuries of all kinds; for in all of them sepsis, and hence infection, are possibilities. As an evidence of extensive or general systemic infection it is a symptom of grave significance. With the diathetic diseases, tuberculosis, syphilis, and rheumatism, its significance is less grave than with the acute infectious diseases. In this variety we cannot refer to a specific microbe as its origin. Some of the conditions with which it may be associated have such origins (diphtheria, pneumonia), and whether the complicating parotitis is due to the irritating effect of such specific germs which have been retained within the gland, or whether it is caused by those germs (streptococcus, staphylococcus) which produce severe inflammation wherever localized, we do not as yet know.

Incubation.—The period of incubation of parotitis is a long one, but it varies with the resisting power of the individual and the virulence of the infective material. The long period of incubation, with the complicating conditions which may arise in the mean time, may delay the determination of the diagnosis. J. Lewis Smith regards the disease as primarily a systemic infectious one, with an incubation period of nine to twenty-one days; A. Jacobi fixes it at two to three weeks; Dauchez, at fifteen days; Roth, at eighteen days; and Nicholson reports a case in which an interval of six weeks elapsed between the involvement of the two parotid glands.

Symptoms.—The long period of incubation may be attended by symptoms of impending trouble. This is especially true with young children. There may be malaise with moderate rise of temperature for several days, and with very young children there may be convulsions, especially if digestive disorder coexist. With glandular swelling come also induration, sensitiveness, pain on motion of the neck or jaw, loss of appetite, restlessness, and insomnia. With the progress of the inflammation infiltration of the gland and the surrounding tissues increases, and fever is more pronounced. These symptoms

may continue for a week, and gradually subside, or the duration may be less prolonged. The induration will gradually disappear and normal conditions be resumed, or the gland may be permanently enlarged or it may atrophy. In a certain number of cases abscess or gangrene will ensue, the gland will be destroyed, and the final result be fatal; but in the great majority these are cases in which the system is so saturated with septic products that the outcome would be fatal even if parotitis did not exist.

The inflammatory action which involves the parotid glands may include also the other salivary glands, and even the cervical lymphatic glands. These complications are frequently overlooked, being overshadowed by the more extensive and apparent affection of the parotids. The appearance of an individual with parotitis is sufficiently characteristic: there is glandular swelling, with hardness and pain; the swelling may be considerable or inconsiderable, and of course the disfigurement of the face and neck will be governed accordingly. The pain is constant and severe, especially in young children; deglutition is difficult and often impossible on account of its painfulness. If abscess develops, the pain has the acute throbbing character of abscess-formation everywhere. Pain in the contiguous structures of the ear is almost always a marked feature of the disease, and the nearness of the carotid artery and cerebral meninges introduces elements of danger which must always be remembered, for serious results in this quarter are by no means unknown. Considering the possibilities of serious consequences, the small percentage of fatal cases when the disease is uncomplicated is quite remarkable.

Complications.—In the traumatic form, in which the inflammation is a simple one, complications are unusual. The inflammation subsides, as such conditions do elsewhere, the result being resolution in the mild cases and suppuration in the severe ones, especially if the tissues have been bruised and broken. In the epidemic infectious form complications are extremely common, the genital organs being most frequently implicated. Thus with males there is often an involvement of the testicles, spermatic cord, and inguinal glands; with females, the mammæ, ovaries, labia majora, and inguinal glands. These complications may not be evident until the symptoms in the parotid gland have begun to subside. In a recent epidemic in which one hundred and seventeen cases were observed by Demme, two were fatal from gangrene of the parotid glands; in three there was abscess of the cervical glands; in two there was acute nephritis. Musgrove and Slagle each saw a fatal case complicated with uræmia. P. Smith saw two cases which were followed by insanity, and Parrott one which was complicated with orchitis and meningitis. F. W. Brown records an epidemic of twenty cases in a boys' school, ten of which were complicated with orchitis. Jackson observed four cases complicated with influenza. This latter complication is more frequent than is generally supposed. The writer recently saw such a case in an infant fourteen months old.

Among the sequelæ of the disease Joffroy mentions peripheral neuritis, with paralysis of the extremities lasting four months. Rotch and Moure each saw two cases of deafness; and Dufour, inflammation of the lachrymal glands. The evidence is therefore abundant that we have in parotitis an infectious disease with multiple localization.

Treatment.—If the disease be, as it appears, an infectious one, we have, as yet, no method of treatment for aborting it. When the symptoms are apparent, the indication is to relieve them as they arise. The pain may be soothed by small doses of Dover's powder or paregoric, or phenacetin combined with salol. Hot applications to the inflamed parts are always grateful, and the surface may be kept moist with anodyne liniments. The bowels must be

kept open, fever may be reduced with aconite, and the diet must be fluid and concentrated. Hot liquids will usually be preferable to cold, and will be more quickly assimilated. The skin should be kept active by daily warm baths, by alcohol, and by gentle friction. The opiates suggested will usually be sufficient to relieve restlessness and induce sleep. As soon as the acute symptoms have subsided the nutrition should be improved as rapidly as possible, and a tonic of iron, quinine, strychnine, and arsenic will be indicated.

Quarantine.—An important practical question is that relating to the time in which patients with infectious parotitis should be isolated. This especially concerns children who are attending school. A recent paper by Rendu is devoted to this aspect of the subject. His studies have led him to believe that the time of greatest danger of contagion is at the close of the incubation period, at least twenty-four hours before the disease can be diagnosticated. Sevestre and Comby had reached this same conclusion. If this be a fact, Rendu's opinion that it is irrational to keep children out of school three weeks after the symptoms of the disease have subsided is a just one, and teaches that isolation should be limited to a period included between the time when the first symptoms appear and the time when the active symptoms have subsided.

WHOOPING-COUGH.

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Synonyms.—Pertussis; Tussis convulsiva; Hooping cough; Chin cough.

Whooping-cough is a zymotic, contagious disease of childhood, characterized by a catarrh of the respiratory mucous membrane and a peculiar paroxysmal cough.

No description of any disease resembling pertussis can be found in the writings of the Greeks, Romans, or Arabians, and it seems probable that the failure to mention such a peculiarly characteristic disorder is proof that it did not then exist at all, or at least in parts of the world with which medical writers were acquainted. In fact, no account of it is found until Baillou, in 1578, described an epidemic which occurred at Paris, and spoke of it as an affection not previously known. Little or nothing more was heard of it for about a hundred years, when Willis wrote of "*tussis puerorum convulsiva*" in such a manner that its nature and its identity with the pertussis of the present day can admit of no doubt. Epidemics did not become frequent until the eighteenth century, but the disease then rapidly spread, and by the middle of that century had become widely diffused. From that period onward it has been steadily on the increase, until it constitutes at present one of the commonest diseases of childhood.

Etiology.—There are certain factors which seem to exercise a decidedly predisposing influence upon the development of pertussis. There is a very distinct tendency shown for it to occur in epidemics, which appear at intervals of about two years, yet with no great regularity in this respect. The disease may, however, occur sporadically, although such cases are always the result of some preceding case. In the larger cities it is practically endemic, although at times greatly more prevalent than at others.

The previous occurrence of the disease in an individual precludes the development of a second attack. Nevertheless, undoubted exceptions to this rule have been occasionally reported, though they are certainly rare.

Whooping-cough is more prevalent in the civilized portions of the world, but its absence from any region seems to depend rather on the fact that it has not yet been carried thither than on any conditions of climate or of race which are unfavorable to its existence. The influence of season has been much disputed, and the evidence is conflicting. It is certainly no powerfully predisposing factor. The station in life and the general hygienic conditions existing appear to be without influence, except in so far as the ill-ventilated houses of the poor may possibly favor the increase of the germs in number or in virulence, even as the crowding and lack of isolation certainly favor their diffusion.

The previous state of the health seems to possess some predisposing power.

Most observers agree that weakly, sickly children more readily contract whooping-cough than do those in good health. It is a well-recognized fact, also, that there is an intimate association between epidemics of measles and of whooping-cough, and it is very widely believed that the existence of the first disease strongly predisposes to the later development of the second. Whether or not the association is an accidental one is still unsettled. The actual presence of any other disease is certainly no bar to the occurrence of pertussis. As with other infectious disorders, there exists a certain individual susceptibility to it. Some children never contract it, though often exposed.

Age exercises a powerful influence on the development of whooping-cough. By far the greater number of cases occur before the sixth year. After this time the frequency of occurrence diminishes very rapidly, and after the tenth year it is comparatively infrequent. West estimates that over one-half the cases develop under the age of three years. It is sometimes seen in adults, but this is rather uncommon; the rarity being due partly to the fact that so many have suffered from it while children, and partly to a lessening of the susceptibility with advancing years. It is not common during the first six months of life. It is, however, distinctly more liable to occur at this time and up to the age of one year than are the other infectious disorders of childhood. There are even a few well-authenticated cases reported in which it appeared to have been contracted during fœtal life.

It has been widely stated that girls are more liable to develop whooping-cough than are boys. Statistics, however, are somewhat at variance, but certainly show that there is no very material difference in the number of each sex attacked.

The sole exciting cause of pertussis is contagion, and so powerful is this contagiousness that by far the greater number of children exposed to the disease will contract it. It is contagious during any part of its course, but particularly in the paroxysmal stage. It is least so in the terminal stage. The nature of the infectious principle can best be discussed when considering the pathology of the affection.

As a rule, actual contact with, or close approach to, the sick child is necessary for its development in a second case, but even a momentary exposure of this sort is often sufficient to ensure an attack. Several observers have claimed that the disease does not spread readily in well-ventilated and roomy hospital wards. My own experience has not been at all in accord with this. The infectious germs appear to be located in the secretion of the respiratory tract, and are spread by this and by the expired air. Cases have been reported which show that whooping-cough is mediately contagious through a third party or through handkerchiefs or clothing which have presumably been infected by the sputum of a patient. It is probable, however, that the disease is rarely contracted in this way.

The contagiousness of pertussis extends slightly to the lower animals, and cases are on record in which these have contracted it from the human subject.

The path by which the germs enter the system is not certainly known. Although nearly all the evidence is in favor of the respiratory tract, the few published cases of pertussis in the new-born indicate the possibility of their entrance in other ways, as by the fœtal circulation.

Pathology.—There are no post-mortem appearances characteristic of pertussis. The most constant change found is redness and swelling of the mucous membrane of the respiratory tract, with the presence of a considerable quantity of viscid mucus. There is often observed a tendency to congestion of various parts of the body, due to the disturbance of the circulation which naturally

attends the paroxysms. There are also found the various lesions corresponding to the complications which have existed during life.

The nature of pertussis has been a much-mooted question, and is not even yet entirely settled. It has been frequently claimed that the disease is a functional disturbance of either the pneumogastric, phrenic, recurrent laryngeal, or sympathetic nerves or of the medulla. According to this view, it is simply a neurosis. Other writers have viewed it as a simple bronchial catarrh due to cold merely, with which is associated a certain nervous element. Enlargement of the tracheal and bronchial glands has also been urged as the cause of the disease, through their irritating pressure upon the terminal filaments of the pneumogastric nerve.

The eminently contagious nature of whooping-cough, its occurrence in epidemics, the existence of a period of incubation, and the immunity from second attacks seem to prove beyond a doubt that it is to be classed among purely infectious disorders. Although this is the view which has recently found very general acceptance, it is by no means a new idea. Even Linnæus attributed pertussis to the presence in the nose of the larvæ of insects. Poulet discovered bacteria in the expired air of patients with pertussis. Letzerich found a micrococcus in the sputum which he believed to be the specific germ, and was able to produce the disease in animals by introducing the secretion into the trachea. Deichler claimed that there was always present in the sputum an organism of the nature of a protozoon which possessed amœboid motion. But, although other investigators have repeatedly described various organisms as existing on the respiratory mucous membrane, the researches of Afanassiew in 1887 have attracted the most attention. This observer isolated a short bacillus, which he named the *bacillus tussis convulsivæ*, and of which he was able to obtain pure cultures upon various media. Animals inoculated upon the respiratory mucous membrane with these cultures exhibited some of the symptoms of the disease and developed catarrhal conditions of the respiratory tract, with a tendency to broncho-pneumonia. These observations have been confirmed by others, and a toxine has also been reported as present in the urine of patients with pertussis which is identical with that produced by Afanassiew's bacillus.

Even though it be admitted as most probable that some micro-organism is the cause of the malady, it is by no means clear how the symptoms are produced or where the principal seat of the infection is. Some writers have claimed that the trigeminal nerve is in a sensitive state, and that it is the irritation of its terminal filaments by the infectious catarrhal process on the nasal mucous membrane which brings on the paroxysms by a reflex action. Others, again, have stated that the bronchial mucous membrane is the portion of the respiratory tract chiefly involved, and that the terminal filaments of the pneumogastric are those irritated. The careful investigations of Meyer-Hüni and of v. Herff, however, indicate that the catarrhal inflammation is most pronounced in the mucous membrane of the nose, larynx, and trachea down to the bifurcation, but especially so on the posterior wall of the larynx in the inter-arytenoid region, the so-called "cough region." In the production of the cough it would seem probable that a small quantity of mucus, perhaps arising from below, accumulates upon the surface of the "cough region," and there irritates powerfully the hyper-sensitive filaments of the superior laryngeal nerve. Through a reflex action a series of clonic spasms of the expiratory muscles is then set up. At last the crowing inspiration occurs, this depending upon a spasm of the glottis, which, in its turn, proceeds from an irritation of the convulsive centres in the medulla. This process is repeated again and again until the offending secretion is expelled.

The presence of this secretion does not seem, however, to be an essential to the production of the cough, since paroxysms may be brought on by excitement and other causes. This appears to indicate that the irritation of the superior laryngeal nerve may be central, due to systemic infection. A great preponderance of the nervous element of the disease over the catarrhal is further shown by the greater frequency with which the paroxysms occur at night, since this condition very possibly depends upon a less degree of resistance of the respiratory centre during the night, and a consequent greater ease with which convulsive expiratory efforts are brought about.

We therefore clearly have to do in whooping-cough with an infectious, catarrhal process which affects particularly, and produces an unusual sensitiveness in, the mucous membrane presided over by the superior laryngeal nerve. But still more prominent is a great excitability of the nerve itself and of the other nervous portion of the respiratory apparatus, this being probably due to the circulation in the blood of some noxious substance, the product of the infecting germs, which possesses a special power over the portion of the nervous system which controls cough. The apparent value in many cases of local treatment directed to the respiratory mucous membrane indicates that the abode of the germs is in this region, whence the poisonous products of their growth are absorbed. On the other hand, the existence of pertussis in the new-born, the result of fœtal infection, points to the presence of the microbes themselves in the circulation and in other parts of the body besides the respiratory tract. From this point of view their situation in the latter region would be a localization entirely secondary to the general systemic infection and, so to speak, *excretory*. Which of these theories is correct cannot as yet be determined, although the resemblance of the disease to other infectious disorders certainly supports the latter view.

Incubation.—A period of incubation precedes the development of the symptoms. Its exact duration cannot be easily determined, since the onset of the disease is so insidious, and statements vary in regard to it. It is clearly somewhat variable in length, and probably lasts from two to seven days, with an average of three to four days.

Symptoms.—It is customary to divide the course of the disease into three stages: 1st, the catarrhal or premonitory stage; 2d, the paroxysmal or convulsive stage; and 3d, the terminal stage or stage of decline. This classification is convenient, but somewhat artificial, since the stages only very gradually pass into each other, and their duration cannot, therefore, be accurately determined.

1. *Catarrhal Stage.*—There is little in this which is characteristic of the disease. The child gradually begins to exhibit symptoms of a severe cold, with malaise, perhaps slight hoarseness, stoppage of the nose, tickling in the throat, sneezing, irritation of the eyes and a dry, annoying cough. Fever is generally slight and apt to come on in the evening only. Although it has been claimed that the elevation of temperature is an evidence of the infection, it is more likely that the degree of fever is dependent solely upon the intensity of the catarrh.

Under treatment there may be a temporary improvement in some of the symptoms, but all of them soon return in force, and the cough particularly is troublesome and gradually grows worse in spite of medicine given. As days pass by it shows a greater tendency to occur in long, severe paroxysms, and is also much more annoying by night. On examination of the chest only a very few râles may be heard. Nothing, indeed, is found to account for the severity of the cough. Sometimes, though less commonly, the first stage is characterized

by a severe bronchitis, with corresponding auscultatory signs and the presence of high fever.

The duration of the first stage averages about two weeks, but it is subject to great variations. Sometimes only two or three days elapse before the child begins to whoop. The younger the age, the shorter, often, is the duration of the catarrhal stage. In some instances the disease never passes beyond the first stage, the diagnosis in such cases depending largely upon the existence of the affection in other members of the family.

2. *Paroxysmal Stage.*—The complete development of the paroxysmal cough marks the beginning of the second stage. The exact time of onset is, as already stated, often difficult of determination. Except for the rarer cases in which the whoop never occurs, it is convenient and most customary to date the paroxysmal stage from the first appearance of this symptom.

The paroxysm of pertussis—or the "kink," as it is frequently called—is very characteristic. Just before it begins the child seems anxious and irritable, or perhaps very quiet. It experiences some sort of a warning sensation, as a pain in the region of the sternum, or nausea, or a tickling in the nose, or a similar sensation in the larynx with an irresistible desire to cough. It at once drops its playthings, runs to its mother or nurse, or grasps some near object for support; or, if asleep, quickly rises, sits upright, and begins to cough. Sometimes, however, the cough seems to come suddenly, without the premonitory sensation. The cough consists of a number of short, explosive expiratory efforts very rapidly following one another, and without any inspiration between them. These continue so long and are so violent that the face becomes turgid and cyanotic, the tongue is protruded and driven against the teeth, saliva flows from the mouth, the eyeballs are prominent, the eyes water, and the pulse becomes rapid and small. The paroxysm lasts a few seconds until at last both cough and all respiration cease. Then comes a peculiar, loud, crowing inspiration, the *whoop*, which is the result of the air passing through the spasmodically closed glottis. Immediately there begins another series of expiratory efforts, to be again followed by the whooping inspiration; and this process repeats itself several times. The later series of expulsive efforts is accompanied by abundant expectoration of ropy mucus and very often by vomiting. As the paroxysm ceases the cyanosis disappears, and the child is often left pale and exhausted for a short time; but if it is strong and otherwise well it soon resumes its play. Sometimes a crowing inspiration immediately precedes the first series of expirations. Occasionally, too, after the attack seems to be over there is a period of rest for a moment, and the whole process is then repeated. A series of paroxysms may thus continue for as long as ten to thirty and even more minutes. The usual duration of an attack, however, is from a few seconds up to one or two minutes. The swelling of the face, the puffiness of the eyes, and some degree of blueness of the tongue persist more or less between the paroxysms, and may constitute quite notable features of the disease. In bad cases the paroxysms may be attended by hæmorrhage from the mouth or nose or beneath the conjunctiva or elsewhere. Involuntary voidance of urine or fæces may be occasioned by the violence of the attack.

The frequency of paroxysms and their intensity vary greatly. In mild cases there may not be more than six to twelve in the twenty-four hours, while in the severer ones they may number from forty to eighty. They are always more numerous at night. An attack of coughing is often brought on by exercise, crying, singing, loud speaking, eating or drinking, excitement of any kind, a sudden change of temperature in the air, or the breathing of air

overloaded with carbonic dioxide. Depression of the tongue with a spatula, producing gagging, is very apt to bring on an attack.

The general condition of the patient does not suffer materially in mild cases. Sometimes, however, there is much exhaustion from the frequent coughing and the loss of sleep, or vomiting may so regularly follow the paroxysms that the nutrition suffers greatly and emaciation becomes marked. In the milder cases vomiting does not at all interfere with the appetite, and the child is soon ready to eat again; so that quite sufficient food is retained for the bodily needs.

More or less fever may occasionally be present in the second stage, especially at night, but, as a rule, fever is absent, and if continuously present makes the existence of some complication probable. The urine in whooping-cough sometimes contains sugar and frequently albumin. It was at one time claimed that it was always saccharine. Auscultation of the chest in the interval between the paroxysms reveals nothing abnormal, or only the presence of a few mucous râles. During the whooping inspiration nothing at all, or at most only a very feeble inspiration, can be heard. During the expiratory efforts, too, very little respiratory sound is audible, and scarcely more than the sensation of a series of impulses can be perceived.

The total duration of the paroxysmal stage is exceedingly variable. In general terms it may be given as from three to six weeks, but it may last a shorter or a much longer time than this.

3. *Terminal Stage.*—The second stage merges so gradually into the succeeding one that no exact boundary between them can be recognized. The third stage may be said to begin when the severity of the disease is clearly diminishing. The attacks now grow less frequent and less severe; the whooping and vomiting persist for a time, but gradually disappear; and the cough, although still paroxysmal, grows distinctly looser and of a more catarrhal nature, and finally assumes the character of that of simple bronchitis. Hæmorrhages occur much less frequently, if at all; the bronchial secretion is now more muco-purulent, and the general health, if previously affected, improves. Finally the cough disappears entirely and the disease is over.

The duration of this stage is very variable. It may last from about ten days up to several months, depending upon hygienic and other conditions. Thus the approach of the winter season is liable to prolong it indefinitely. Not infrequently, after all cough has ceased and the child has appeared well, the development of a nasal or bronchial catarrh may be attended by a return of the paroxysms. Such a return cannot, however, be properly designated a part of the third stage.

Complications and Sequelæ.—Of the very numerous complications of pertussis those connected with the respiratory tract are most prominent. Bronchitis may be so in excess of the degree of catarrh usually present that it constitutes a complication. This is not an infrequent occurrence. Atelectasis very often develops in young children. It may affect only a small part of the lung or may be more extensive and threaten life, and is especially apt to be witnessed in weakly and rachitic children. Widespread broncho-pneumonia is one of the most common and most dangerous complications of whooping-cough. It usually comes as a result of atelectasis, but sometimes independently of it, and tends to run a very tedious course. As it develops the paroxysmal nature of the cough is very liable to diminish or disappear. Like atelectasis it is particularly prone to be seen in weakly children or when measles has immediately preceded pertussis, or in children who have been subjected to improper hygiene, especially exposure to cold. Pleural effusion,

empyema and croupous pneumonia are of less frequent occurrence; pneumothorax is rare; emphysema is common, but is generally only temporary. Sometimes, however, it is permanent throughout more or less of the lungs. Emphysema of the subcutaneous connective tissue has been reported but is very uncommon. Œdema of the glottis is sometimes seen. The coexistence of pseudo-membranous laryngitis is to be regarded as accidental.

A complication so frequent that it almost deserves to be called a symptom is the occurrence of a superficial yellowish-gray ulceration over or at the sides of the frænum of the tongue. It is probably produced by the forcible impulse of the tongue against the lower incisor teeth during the act of coughing. It has occasionally been seen in other disorders than whooping-cough.

Vomiting is generally to be regarded as a symptom of the disease, but the irritability of the stomach may become so great that it constitutes a genuine and very troublesome complication. In such cases vomiting is very frequent and takes place after every slight cough. Loss of appetite, indigestion, and diarrhœa are common complications, the latter being of a somewhat chronic nature, with the evacuation of considerable mucus. Prolapse of the rectum may result from the violence of the cough, and hernia may be brought about in the same way.

Hæmorrhages from various parts of the body occur during the paroxysms. Bleeding from the nose and mouth is so frequent that it is to be included among the symptoms of the disease. Subconjunctival hæmorrhage is not uncommon. Bleeding from the ear is a rare complication and hæmorrhage from the lungs is also unusual. Hæmatemesis, in which the blood comes originally from the stomach and is not previously swallowed, is certainly exceptional. Hæmorrhage into the skin occasionally occurs. Hæmorrhage into the meninges or within the brain is not an unusual complication, and is doubtless the cause of many instances of convulsions and other cerebral symptoms.

Convulsions are a dangerous complication and are not infrequent, particularly in young subjects. A persistent spasm of the glottis may sometimes cause death. Hemiplegia, aphasia, sudden blindness and other evidences of cerebral disturbance may be occasional complications.

General œdema of the skin has sometimes complicated the disease. Acute nephritis has been quite often reported.

Whooping-cough may be associated with diphtheria, varicella, scarlatina, or, in fact, any of the infectious diseases, but particularly with measles. The latter combination especially renders the prognosis more unfavorable.

Rachitis, anæmia and other constitutional maladies may complicate pertussis and influence its course unfavorably, or they may develop as sequels to it. Tuberculosis is a sequel very liable to arise in those who are predisposed to it or whose general nutrition has greatly suffered during the first disease. Its usual seat is the bronchial and intestinal glands or in some of the patches of broncho-pneumonia, but from these foci a more or less widely-spread infection may start. Epilepsy, various paralyses, aphasia, blindness, deaf-mutism following rupture of the drum-membrane, disseminated sclerosis and other conditions have been reported as occasional sequels. Some of them are to be viewed as accidental merely.

Diagnosis.—In the early stages of the disease the diagnosis can seldom be made with any certainty. The absence or scarcity of physical signs in the lungs, combined with the very harassing cough, which is markedly worse at night, renders the case suspicious. This is especially true if whooping-cough be prevalent at the time, or if there be a history of exposure to contagion. If the cough assume a decidedly paroxysmal character, the diagnosis becomes still

more probable. The occurrence of the whoop is usually conclusive, and even in those cases where this at no time develops, the nature of the cough, with such attending symptoms as vomiting, injection of the conjunctivæ and the like, makes the diagnosis fairly easy.

Severe acute bronchitis of the smaller tubes may sometimes be attended by a very spasmodic cough and may simulate pertussis closely; but the presence of numerous râles, with decided fever and dyspnœa, and the absence of more than a slight whoop will aid in distinguishing it. The same difficulty in diagnosis, and for similar reasons, may exist in cases where pertussis closely follows measles, since the severe bronchitis already present may appear to account fully for the severity, and even the paroxysmal nature, of the cough. The development of broncho-pneumonia during the first stage of pertussis may render the later diagnosis very difficult, since it is apt to modify greatly the character of the cough or even to prevent entirely the occurrence of the whoop. Tuberculosis of the bronchial glands may produce a paroxysmal cough much resembling that of pertussis. It is to be distinguished by a history of previous wasting and ill-health, the chronic course without distinct stages, the imperfect development of the paroxysms, which are unattended by abundant mucous expectoration or vomiting, and the presence of fever. Sometimes evidences of tuberculosis of the lungs are also present. A prolonged third stage of pertussis may readily simulate pulmonary tuberculosis, and, indeed, it may be possible that the latter disease is developing as a sequel. Only the later course of the case can decide.

Prognosis and Mortality.—Although the prognosis is favorable in most cases, yet pertussis is a far more dangerous disease than is ordinarily supposed. In England and Wales 120,000 persons died of it between the years 1858 and 1867, and 85,000 succumbed in Prussia between 1875 and 1880. Dolan ranks it third among the fatal diseases of childhood in England, and says it causes one-fourth of the annual mortality among children in London. Smith estimates that during fifty years there were 4840 deaths from it in New York City, or 1 in every 76 deaths from any cause. The relative mortality, as compared with the number of cases of the disease, is also larger than is commonly believed. Statistics vary regarding it, but it may be said to range from 3 to 15 per cent.

It is upon the great frequency of the complications that the high rate of mortality depends, for, if uncomplicated, the disease is not often dangerous. The younger the child the more unfavorable is the prognosis. The mortality is very much greater under two to three years of age than after this period, while after the fifth year it is trifling. The prognosis is rather more unfavorable in females than in males, owing possibly to a less degree of strength of constitution possessed by the former. The patient's previous general condition and the amount of care received while sick affect the prognosis very materially. The children of the poor, badly nourished and neglected as they so frequently are, are consequently apt to suffer most. Rachitis or any other constitutional debilitating disorder influences the course of the disease unfavorably. The presence of the winter season increases the danger through the greater liability of respiratory complications. On the other hand, the heat of summer brings on debilitating intestinal disorders. As already stated, convulsions and broncho-pneumonia are frequent and dangerous complications and the cause of many deaths.

Many cases pass safely through the attack, but die from the sequelæ. Some become marasmatic and die without the exact cause being discovered, although many of these are undoubtedly tubercular. Other cases show definite symptoms of tuberculosis of various parts of the body.

Treatment.—*Prophylaxis.*—In view of the highly contagious nature of the disease prophylactic treatment should be carefully carried out. Children who have not yet suffered from it should be rigidly kept from the slightest intercourse with those who are even suspected of being in the first stage of the malady. Inasmuch as there exists the greatest possible carelessness on the part of parents of the sick regarding the danger to others, it is better that uninfected children be removed entirely from the neighborhood whenever feasible. Particularly is this true in the case of delicate infants.

How long the danger of infection continues and how long quarantine must be maintained are not absolutely certain. It is admitted that the infectiousness diminishes during the third stage, and it may be assumed that by the end of two months after the onset of the disease the danger has entirely ceased. A still better criterion, however, is the entire cessation of the cough.

If, after the child has been apparently entirely well for a brief period, the cough, with or without the whoop, returns, it is probably safe to consider that the risk of infection is over in spite of this. It often happens that the whoop will thus return at intervals during months, or even for a year, whenever slight bronchitis is contracted. Quarantine during this entire period is manifestly unnecessary and impossible. The same is true of those cases which continue to whoop once or twice a day for an indefinite time. In such we may consider that after two, or at most three, months the disease itself is over, and that simply a neurosis remains: the "habit," so to speak, of whooping persists.

Although whooping-cough seems in nearly every instance to be communicated by the breath only, yet, to avoid the possibility of transmission in other ways, disinfection of the clothing, bed-linen, and the like should be carried out systematically, and the rooms used should receive a final disinfection before being inhabited by other children.

Treatment of the Attack.—The hygienic treatment of pertussis is of the utmost importance. Inasmuch as air loaded with carbonic dioxide has been proven to bring on paroxysms of cough, children should be kept in fresh air as much as possible. At the same time the very great sensitiveness of the respiratory mucous membrane must be borne in mind, and all possibility of taking cold must be avoided. In winter, therefore, it is often best to confine the patient to the house except on dry and still days. Where possible it is well to utilize two airy rooms, one of which shall be thoroughly ventilated and then warmed while the other is in use. The child can be changed from one to the other several times a day. The clothing should be warm enough to prevent chilling and consequent taking cold. The food should be nutritious, easy of digestion and assimilation, and frequently administered in cases where vomiting is a prominent symptom. In some cases of this kind it may be necessary to employ nutrient enemata.

It sometimes happens that change of climate will act most favorably upon the course of a case of pertussis. This is particularly true of the third stage if unusually prolonged.

The host of remedies recommended for pertussis is proof in itself that none of them constitute an infallible cure. Rather, however, than decry all medication, as is the habit with some, we should remember that negative results in the hands of one physician cannot vitiate positive results with any certain method of treatment in the hands of another competent observer. Nothing is more certain than that, although no medication is curative in all instances, many different methods of treatment are of undoubted value in different cases. Where, therefore, we fail with one, another must be tried in the effort to discover the remedy useful for the particular case. It must also be borne in mind

that to test the value of a remedy we must give it in sufficiently large dose, and further that it must be administered at the height of the disease, and not when the third stage has already commenced, at which time almost anything may seem to do good.

In the mild cases, where paroxysms are but few and of little severity, it is best to omit all medication intended to control the disease, and simply to keep a careful supervision over the patient. In severer cases, however, treatment is demanded. The condition existing in each individual case,—and, to a less extent, the stage of the disease—will exert an influence upon the choice of drugs to be employed. During the first stage, when the cough is hard and tight, with little expectoration and without full development of the paroxysmal character, the medicines to be selected are those useful in an ordinary bronchial catarrh. The same plan of treatment may be needed in the second stage, while in other cases the copious expectoration permits the freer use of sedatives. But inasmuch as the cough from the outset does not depend upon a simple bronchial catarrh, it is oftener better to begin the employment of remedies directed against the peculiar nervous character of the disease as early in the case as the diagnosis can be made. This need not interfere with any symptomatic treatment indicated. When the third stage is well under way attention must be paid principally to the accompanying bronchitis. Stimulating liniments to the chest may be useful, and tonic remedies are often demanded.

An attempt to consider all the drugs which have been employed for the treatment of pertussis would be so much a waste of time and space that only the most important of them can be mentioned here. Belladonna is one of those best and longest known and most widely used. Sometimes doses of moderate size suffice, but in other cases it is necessary to give it in increasing amounts until constitutional effects are seen. It often does great good, and often, too, entirely fails to relieve. The initial dose for a child of two years may be two minims of the tincture or one-twelfth of a grain of the extract three or four times a day. Alum is sometimes of distinct benefit, particularly when the abundance of the secretion appears to be the cause of frequent paroxysms. It may be given in doses of two grains every three or four hours at two years of age. It may sometimes be combined advantageously with belladonna. Quinine has been widely used with varying results. On the whole, it may be considered a useful remedy. When given internally the doses should be rather large—as one grain every two to four hours at two years of age—to produce an effect upon the disease; but there is risk of disturbing the digestion with it. It may be administered with advantage in suppositories, or, if by the mouth, disguised in syrup of yerba santa or syrup of licorice. Chloral is often useful to produce sleep at night. Two to four grains may be given at bed-time to a child two years old. There is some evidence that, administered at intervals during the day, it exerts also a direct influence upon the course of the disease. It can be exhibited either by the mouth or by enema. Its power of depressing must not be forgotten. Opium is frequently of the greatest service in obtaining temporary relief. Comparatively restful nights can often be procured by means of its administration at bed-time. It should, however, be reserved for the severest cases. Bromide of potassium or of some other base has been much recommended, and is often of distinct value. It lessens the nervous irritability, and in this way diminishes the frequency and intensity of the paroxysms. Its administration should be started immediately if evidence of nervous disturbance indicate impending convulsions. The dose at two years of age may be two to five grains, repeated according to the demands of the case. It may often be advantageously combined with belladonna. Cannabis

Indica has been much used, and is probably one of the most reliable means of treatment. Asafœtida is still a favorite with many. Carbolic acid, in doses of one minim at two years of age, has been found of service in many instances, but its toxic properties must not be forgotten. Peroxide of hydrogen has been highly praised, as have terpene hydrate and infusion of wild thyme. Ouabaine has been highly recommended. The dose is one-thousandth of a grain every three hours at five years of age. It is a powerful respiratory paralyzer.

Among the most important of other drugs which have been recommended for internal administration, and which have doubtless proved of service in some cases, are pilocarpine, lobelia, resorcin, grindelia, castania, drosera, camphor, quebracho, hyoscine, turpentine, benzole, carbonate of iron, and conium.

Antipyrine, first recommended by Sonnenberger, has been used with excellent results by so many that its value in the disease is now beyond question. Although, like other remedies, it often fails to relieve, many of the reported failures with it are doubtless due to the fact that it was not given in sufficiently large dose. Children bear it surprisingly well, and bad results following its administration are rare. The initial dose should be small, and the amount gradually increased until a child two years old receives one to two grains, or even more, every three hours. In a desperate case of pertussis in a four-months-old child under my care, in which three-quarters of a grain of antipyrine, given every three hours, failed entirely to relieve, an increase of the dose to one grain every three hours rapidly brought the patient from a condition of the greatest danger to one of comparative health. The child had suffered from very frequent and violent attacks of cough, followed by spasm of the glottis of so long duration that intense cyanosis with entire apnœa and loss of consciousness repeatedly resulted. Within forty-eight hours after the treatment had been instituted the little patient had passed an entire night and and until afternoon on the next day with but a single paroxysm.

Phenacetin will sometimes be of service in cases where antipyrine has failed, and the reverse, of course, also holds good. Acetanilid has sometimes proved of use, but is less often employed and of less value than are its two cogeners.

Bromoform, one of the newest remedies for pertussis, was first recommended by Stepp in 1889, and has been largely used. It may be given in doses of from two to four drops three or four times a day at two years of age. It can be dropped upon moistened sugar or given in a mixture with alcohol, syrup, and water. My experience with it, although satisfactory to some extent, has not been as much so hitherto as published results had led me to hope. Some cases improved, but oftener small doses failed to be of service, while larger ones rendered the patient so sleepy and stupid that the remedy had to be abandoned. Nevertheless, the large number of reported cases in which the results have been extremely good indicate that the remedy is certainly of great value.

Local treatment of the respiratory mucous membrane has been largely employed. One of the most popular methods is the insufflation of quinine in the form of a fine powder. This may be applied directly to the larynx by the physician twice a day, or nasal insufflations may be made by the attendants several times daily. Excellent results have been obtained in each way. About one grain of quinine should be used at a time. Resorcin has been highly recommended by Moncorvo. A 1 per cent. solution may be applied to the pharynx and the opening of the larynx, or a powder may be insufflated into the nose, using one-half to one grain at a time for this purpose several times each day. The local application of a solution of cocaine has been advo-

cated, but is not without danger, as reported cases have shown. It has, however, often been of service in mitigating the severity of the disease. The solution should be of the strength of from 1 to 4 per cent.

With the steam or hand-ball atomizer the fauces and nares may be sprayed with the substances mentioned or with a weak solution of morphia. Bromide of potassium in solution is sometimes of much service, and tannin can be employed in the same way. Peroxide of hydrogen, in the dilution of one part in five, may be sprayed in the nares and upon the fauces, and very excellent results have been claimed for it.

Benzoin, boric acid, salicylic acid, iodoform, tannin, and other drugs, in powdered form, have found their supporters as useful agents for nasal insufflation. Benzoin is one of the best of them. Good effects can also be secured with boric acid.

Various volatile substances may be used with the atomizer in the form of vapor from boiling water. Carbolic acid is one of the best of these, and it is often of great advantage to allow the sick-room to be permeated by it. The action upon the cough is probably due in part to the anæsthetic effect of the carbolic acid, and largely to the influence of the moist atmosphere of the room, which loosens the mucus and facilitates its expectoration. Thymol, eucalyptol, and turpentine may be vaporized in a similar way. Chloroform and ether have been recommended for their general anæsthetic effect.

Remarkable results have been reported from the fumigation of the sick-room by burning sulphur. The child is to be washed in the morning, dressed in clean clothes, and placed in another room. The night-room is in the mean time thoroughly fumigated with the sulphurous vapor, closed during five hours, and then aired. The patient sleeps in this room at night. A single employment of this procedure has been effective in some cases.

The inhalation of the air in the purifying-rooms of gas-works is a method of treatment formerly much in vogue. The employment of the pneumatic cabinet has likewise been recommended. The use of the constant electric current has been advocated by several clinicians. The routine administration of emetics, once a popular procedure, is no longer in favor.

Complications demand, of course, treatment applicable to them individually.

TYPHOID FEVER.

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Typhoid fever may be defined, and its clinical history fairly outlined, as a disease caused by a specific germ and characterized by headache, continued fever, and a tendency to hæmorrhage and intestinal disturbances. It is a disease which has a special anatomical lesion, characterized by an eruption upon the mucous membrane of the intestines, and in many cases by lenticular spots of similar character upon the integument.

There is every reason to believe that typhoid fever is a disease handed down to us from antiquity. It was undoubtedly known to the ancients and described as a continued fever characterized by diarrhœa, tympany, pain in the abdomen, hæmorrhage from the nose and bowels, delirium, and a tendency to coma. During the early part of the century this disease was particularly studied by the French and Germans, and by Gerhard, Shattuck, and Steele of our country. The non-identity of typhoid and typhus was clearly established about 1838 to 1840, and what is now believed by the majority of students to be the essential bacteriological factor, a characteristic bacillus, was discovered by Eberth in 1880 in the viscera implicated by the disease. Previous to 1840 the opinion prevailed quite universally that infancy and childhood were immune from this disease; but if one reads the article by Stewart (*Diseases of Children*, 1841) entitled "Infantile Remittent Fever," it is readily seen that under this heading he was describing typhoid fever. This disease possibly existed in children during all the generations, but had not been differentiated. If we go farther back and examine the earlier writings of those who devoted themselves to the study of typhoid among the young, we shall find additional evidence of this disease among children. As early as 1817, Abercrombie described a case in a six-months-old girl, and later in a seven-months-old child, and finally, three years later, two other cases. All of these children had the post-mortem results usually found in typhoid fever. In 1822, West described the disease quite fully, not only from a clinical, but from an anatomical, standpoint. Billard, in 1828, published two cases of typhoid in children. Characlay, in 1840, recorded a case of a child eight days old who died from typhoid. It presented enlargement of the follicles and patches of the bowel, and also enlarged mesenteric glands. Shadler narrates a case of a seven-months' child whose mother died on the twenty-sixth day of typhoid fever. Five days after the mother's death the child sickened, and died on the eleventh day. It had ulceration and infiltration of Peyer's patches, swelling of the mesenteric glands, and enlargement and softening of the spleen. Other cases are at my command, but enough have already been recorded. Since the date mentioned (about 1840) typhoid fever in children has received considerable attention, until at this time the fact is established beyond doubt that they not only have the disease, but that, incident to their age, there are characteristics, both

as regards etiology and clinical history, which should receive our consideration. It is particularly noticeable that epidemics take place which principally affect children. This occurs when there is infection of the milk-supply which a considerable number of the young in a community are using for food.

I shall speak of typhoid as occurring first in infants, and second in children. That it is found in infants, as I have previously remarked, there is not a doubt. I desire to cite cases in current literature. A case is recorded in *Keating's Cyclopædia* of an infant six months of age who had the disease. There was no doubt as to the diagnosis, since the pathological lesions were exhibited by Murchison before the London Pathological Society. In the same work is a previously unpublished case of mine, in which is given the history of a child twenty-four months old who had all the classical symptoms of typhoid, followed by intestinal hæmorrhage, the autopsy revealing the usual pathological findings. In the *London Lancet* of Jan. 2, 1892, Dr. Ogle records a case of enteric fever in a child four months and fourteen days old. The pathological conditions were present. The same authority states that Murchison mentions three cases in younger infants—one of eight days, one of fifteen days, and one a fœtus of seven months. Vogel cites seven cases under one year of age, in one the child taking the disease at its birth, the mother being infected. Henoch had eight cases under two years of age, and Montmollin recorded fifteen of the same age. England of Montreal reports a case in a hand-fed infant of eight months. In this case there were vomiting, diarrhœa, tympanites, enlargement of the liver and spleen, rose-spots, and elevation of temperature for three weeks.

The proportion of children over five years of age affected with typhoid fever is as follows: In 280 cases observed by Henoch, 154 were between five and ten years of age, and 62 were between eleven and fourteen years. In 1017 cases observed by Vogel, 412 were between five and ten years, and 393 between the ages of eleven and fifteen. My own observations during the last two years are based upon 21 cases whose histories are very complete, and some 15 or 20 others whose records are not sufficiently accurate to make them of particular scientific value. Of my cases, 7 were under five years, 9 between five and ten, and 5 between ten and fifteen.

Etiology.—The time has come when some tangible cause for typhoid fever must be assigned for its prevalence. It is hardly admissible at this day to state that this fever comes from exposure to the atmosphere, or decomposing logs or potatoes in the cellar, or from some sewer, or from tainted food. The majority of authorities recognize a specific bacillus which is found in every lesion of typhoid fever. These bacilli have been demonstrated in milk and in drinking-water, and in other sources from which it is fair to suppose the infection may take place. This discovery may be stated as one of the triumphs of bacteriology. That the typhoid bacillus has been found in any considerable number of cases of typhoid fever in children cannot be claimed; indeed, in a careful examination of all literature at my command, I do not remember that this peculiar germ has been found in children dying of typhoid under two years of age. Studies must be made along this line. Eberth, however, reported the case of a pregnant woman who, in the third week of an attack of typhoid fever, expelled a twenty-week fœtus still enclosed in its membranes. With rigid antiseptic precautions some blood from the heart, some pulmonary tissue, and some fluid expressed from the spleen were taken from the fœtus. In cover-glass preparations of these, as well as of the blood from the intervillous spaces of the placenta, typhoid bacilli were found. Cultures in gelatin and on potatoes developed typically. Comparative observations upon eight

other fœtuses of non-typhoid mothers demonstrated the absence of typhoid bacilli.

The bacillus is found in every lesion of typhoid fever. This is particularly true of the lymphoid tissues, the spleen, the liver, mucous membrane of the alimentary canal, the blood, and the urine; sometimes it may be demonstrated in the rose-spots and in the ulcerations of bed-sores. It is found in large quantities in the fæcal matter, but it is extremely difficult to separate it from the other micro-organisms which are found in large numbers in the dejections. While my belief is that typhoid is due to the germs which I have described, and that, according to many observers, when the micro-organism under discussion has been experimentally communicated to animals, it causes them to manifest the symptoms of this disease, there are those who do not at this moment entirely accept this theory.

Vaughan, whose work in bacteriology certainly is not to be disregarded, maintains that typhoid is not dependent upon a single specific organism. He admits that the bacillus of Eberth is invariably found in the bodies of those dying from typhoid fever, but he makes a point which is true, that the attempts to introduce typhoid into the lower animals by inoculation has, up to this time, not been absolutely successful.

Space will not permit me to enter into the question so ably presented by Rodet and Roux, whether an organism may be benign in one location and a disease-producing agent in another; that is, whether the bacillus coli communis, which exists normally in the intestines, is converted into the typhoid germ of Eberth outside the body. This, with the crucial test, the successful inoculation in animals, will undoubtedly be demonstrated in due course of time.

The causes which, up to this time, have been supposed to produce the disease, such as bad ventilation, bad sewers, decomposing vegetables, etc., undoubtedly have their influence in favoring its development. All these things furnish a place for the accumulation of the poison, and make those who are exposed to the specific poison more susceptible of taking the disease.

I am not aware that typhoid fever is particularly affected by climate or season of the year. When children are exposed to the infection, it will manifest itself unless the infection is destroyed; and where the water-supply is contaminated or the milk is infected, we should expect the disease, whatever the climate or season may be.

In regard to the entrance of the poison, water is one of the most common means of conveyance, and inasmuch as children have access to all sources of water-supply, it is difficult to give them instructions by which they may avoid it. Milk is undoubtedly a source of infection. The milk which children take may be very easily infected through the water with which it is diluted or with which the cans are cleansed. It is easy for milk to become contaminated with the dust and other impurities which contain the bacillus of typhoid. Taking everything into consideration, it appears to me that children are exposed quite as frequently as adults.

While typhoid fever is not particularly contagious, in the sense of the disease being contracted from personal contact, yet in different ways it is communicated, and precaution should be taken and instruction given to prevent it. I cannot express my belief in regard to the infectiousness of typhoid fever better than by relating the following, which has come under my own observation: Some time in June, 1890, a young man died of typhoid fever in this city. I was not his attending physician, and do not know what general methods of preventing the spread of the disease were taken, but a

very intimate friend of his visited his room a short time after his death, burned some of his clothes, and sent some to his home. In about two weeks this young man was taken with headache and general malaise, and went to his home in Wisconsin and passed through a course of typhoid fever. Two sisters nursed him through his sickness. After his recovery, one of the sisters came to Chicago, and was stricken with typhoid, in which I attended her, while the sister who remained at home also successfully passed through an attack of the disease. An aunt with two of her children visited the infected home, and shortly after presented all the symptoms of typhoid, and one of the children aged three years, contracted it and was sick four months. The sister who nursed this child succumbed to the disease after a three weeks' illness, during which time she had four hæmorrhages. A distant relative of the sister-in-law visited the house, passed through a short course of typhoid fever, and died in three weeks. One servant in attendance also lost her life. In all, some thirteen or fourteen people had typhoid fever, the starting-point of which was a single case in this city.

In my 21 cases accurately recorded 10 were males and 11 females. In Vogel's 1017 cases 870 were boys. In the 35 or 40 cases which I have observed during the last three years the duration has been from seventeen to forty-five days, with an average of twenty-six.

Pathology.—I have already indicated how the specific poison of typhoid enters the body, and, if not destroyed, how it finds favorable conditions for its development. Nearly all the anatomical lesions which we find in adults have been found in children. I have seen the swollen and ulcerated tissues of the mucous surface of the bowel, the opening made by a perforation and its subsequent peritonitis, the enlargement of the mesenteric glands, and a few of the remote pathological changes. Although the bacilli, which are always found in the lymphatic tissues of the bowels, the spleen, and other organs in adults, have not, to my knowledge, been found in children dying of typhoid, I believe that further study and observation will demonstrate their presence. I have already mentioned Eberth's recent investigations, which give all that is at my command regarding the bacilli of typhoid in children. They have not been found in children under two years of age, as far as my investigations have extended, and in recent communications with Drs. Jacobi, J. Lewis Smith, Rotch, and Northrup, no additional information in regard to this question has been received.

Uffelmann remarks that there is almost always redness and swelling of the bronchial mucous membrane, and also adds that the bacilli may be found in the blood, spleen, and other intestinal organs, although he does not state that they have been found in young children.

The lesions as they occur in children, in distinction from their occurrence in adults, have not been well worked out by recent authors. It has been the custom in many cases to simply take the pathology of adults, and imply that the same conditions are found in children. The best study on this subject to which my attention has been directed while writing these pages is by Gerhart, from whose observations I shall freely quote. In children the pathological lesions, whatever they may be, certainly differ from those found in adults, and this is especially true at the beginning of the disease. The swelling of Peyer's patches shows itself earlier and is seen with greatest frequency near the ileo-cæcal valve, although in a considerable number of cases this lesion reaches high up into the small intestine. The patches are swollen to such a degree that they project from the surface of the mucous membrane, and upon these projections frequently are seen small excoriations and little ulcers. It is from

these points that hæmorrhage takes place; and later sloughs and deep ulcers are formed, which may perforate the outer serous coat of the bowel and give rise to peritonitis. In 44 post-mortem examinations of one author, ulcers and sloughs were found in 29. In young children, between two and seven years of age, these deeper pathological changes in the mucous membrane are not found as frequently as they are in older children. After the tenth year sloughing and ulcers are more frequent. The comparative insignificance of the changes which are found in the intestinal mucous membrane in young children, as contrasted with the same more serious pathological conditions noticed in older people, is due to the fact that in children the nourishment is almost universally fluid, and consequently unirritating. If perforation occurs, it usually takes place after the third week, although it may occur before. The mesenteric glands are found swollen in nearly half of the cases, and sometimes reach the size of a pigeon's egg. These glands may soften and rupture into the peritoneal cavity, giving rise, as I have noted in another place in this article, to serious peritonitis. The gall-bladder has been noticed in one case as a seat of infiltration and perforation during typhoid. Swelling of the spleen is found in quite a number of cases, although it can hardly be expected that this organ will be enlarged as frequently as in adults. Rilliet found the spleen enlarged five times in sixteen post-mortem examinations. The liver is also occasionally enlarged. Hypostatic congestion of the lungs is not as frequent as it is in adults, although very serious complications do sometimes find their seat in the lung tissue.

Clinical History.—Typhoid fever in children conforms very fairly to the disease as I have noticed it in adults. This, however, is contrary to the previous experience of some of our best observers, particularly Wilson. According to Unger, the clinical history differs in a great degree in young children. The symptoms referable to the prodromic period, however, are either absent or not noticeable in very young children. The pain in the head so constant in older patients is frequently present in the young. In some cases the parents have noticed that the child has had uneasy nights, rolling and tossing about: in some instances a fever has been present several days before a physician is consulted. There are frequently want of appetite and some diarrhœa, but in the majority of cases the symptoms which cause parents to consult a physician are fever, more particularly during the first two weeks, at night, sometimes a slight diarrhœa or a feeling of weariness, and, in a few instances, nose-bleed. The irritation of the gastro-intestinal canal in typhoid fever is less, not only in children but also in adults, than it was a few years ago. Whether this change has been brought about through a different treatment or from rest in bed, which we make imperative, or because we feed more and medicate less, I am unable to say; but that there has been a change brought about in the clinical history of typhoid during the last quarter of a century there is in my mind no doubt.

Consideration of Individual Symptoms.—*Temperature.*—Fever is usually noticeable from the first, and ranges from 102° to 105.5° F. This symptom is never absent, and begins with a gradual rise in the temperature, marked usually with morning remissions and evening exacerbations. At the end of the first week, in many cases, the fever has reached its height, and may remain at that point, with slight morning and evening variations, until the decline of the disease. There are no sudden, unprovoked jumps in the curve, as in *la grippe* and tuberculosis, and under strong antipyretics the temperature falls easily. Usually at the end of the third week or commencement of the fourth the morning temperature declines. It will usually be found, as Henoch

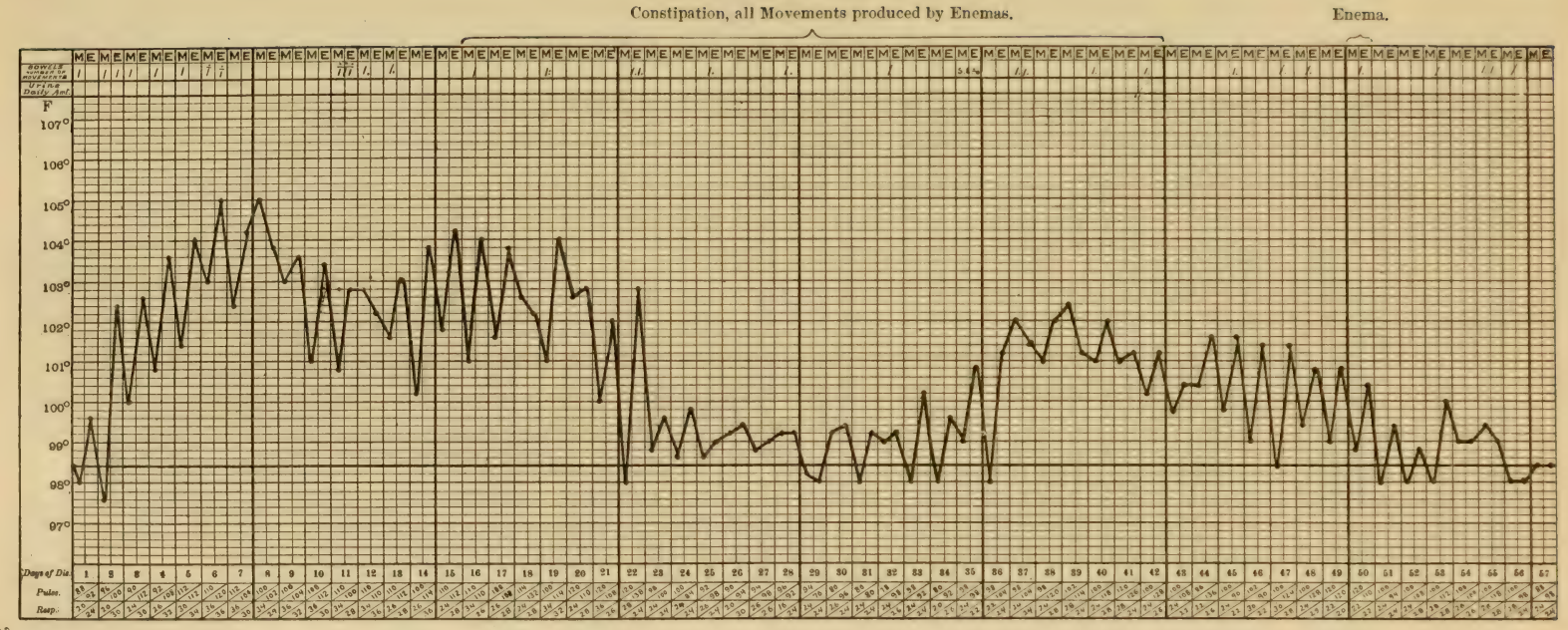


Chart of Temperature, Pulse, and Respiration in Typhoid Fever, showing initial attack and relapse. (Patient ten years old.)

states, that the temperature is somewhat higher in the evening. Children with high fever frequently make excellent recoveries. I have seen recently a temperature of 105.6° for three days, with a subsequent perfectly good result.

Headache.—I have already remarked that this is not as noticeable a symptom as in adults. The reason of this is manifest, since infants and most children locate pain indefinitely. The facial expression and the indication of uneasiness, however, point to this symptom as present in many cases among the young.

Appearance of the Tongue.—The tongue does not have, in all cases, the characteristic redness which we formerly noticed in adults. In the majority of cases it is only slightly coated, while in others there is a heavy coating, with edges slightly red. In some cases the tongue is remarkably clean. I do not now remember seeing any instance of the red, hard, glistening beefsteak tongue that the older authorities refer to. Dr. Christopher of this city believes the conditions of the tongue quite diagnostic of typhoid in children. He describes the coating as thick and heavy over the major part, but leaving the tip and margins free and slightly red. Sometimes he finds a V-shaped reddish appearance in the centre of this organ.

The mouth and pharynx may be the seat of catarrhal inflammation, and in children with poor nutrition there is a tendency to superficial and deep ulceration. Pharyngeal diphtheria is recorded by Vogel as frequent. Noma has also been noticed.

Parotitis.—The parotid gland is the seat of an inflammation late in the disease in a few cases. In my observation it occurred in one case on the right side. Resolution took place without suppuration. Vogel says that the parotid swells sometimes in children during the second week of typhoid, and Strümpell believes that this infection comes from the mouth, finding its way along Steno's duct, and states that proper cleansing and disinfecting will prevent it.

Vomiting.—This symptom will be found in a few cases, severe rarely, but slight in quite a number. In Henoch's table there were 42 cases, and Vogel remarks that this symptom takes place with greater frequency than in adults. The initial vomiting is absent in the very great majority of cases.

Appetite.—There is usually anorexia from the beginning, but with a little urging a sufficiency of fluid food will be taken.

Condition of the Bowels.—Formerly diarrhœa was the rule, but at the present day constipation is present in probably one-third of our cases. Of the 21 cases of typhoid in children which I have recorded, constipation was present in 3, slight diarrhœa in 10, severe in 8. In Henoch's cases 23 were constipated, and in 224 other recorded cases diarrhœa was present in 175. Gurgling and pain may be found in the right iliac region.

Rose-spots.—Pale red, slightly elevated spots, which disappear on pressure, are found in the majority of cases. They are few in number oftentimes, but sometimes not only are very abundant on the abdomen, but are found in great numbers on other parts of the body. They were found in all my cases except 4, 1 of which was seen late, while the other 3 were not specially examined. Henoch says that rose-spots were absent in 15 of his cases, but were usually found. They are noticed generally from the seventh to the eleventh day.

Tympany.—Henoch speaks of tympany as being rare. This was not true in the cases under my observation, as a majority showed more or less distention. In one case a very extreme tympany developed on the tenth day, with marked nervous symptoms; and in a second case extreme tympany developed during

convalescence in association with obstinate constipation. Both symptoms were relieved by free bowel movements.

Hæmorrhage of the Bowels.—In my unpublished case in *Keating's Cyclopædia* this symptom was present, while in our recent epidemic none took place. Henoch noticed it nine times. Vogel says intestinal perforation is rare, and in my own experience it has occurred only once, many years ago. It appears to be a rare accident in children, and with the care in diet now given by every intelligent physician it will undoubtedly take place less frequently than in former years.

Peritonitis in a mild form is probably present in a fair percentage of cases. When severe it is usually due to perforation, although it may become a dangerous symptom even without perforation. In the light of recent pathology this is possible, and may be explained as follows: 1. Microbes, such as the bacterium coli commune and others, may migrate directly through the weakened and partly destroyed intestinal wall, and then attack the peritoneum. 2. Peritonitis may originate from thrombo-lymphangitis and lymphadenitis by direct extension to the peritoneum over the mesenteric glands. 3. A suppurative lymphadenitic focus may rupture into the peritoneal cavity. 4. Peritonitis might originate from the rupture of suppurating infarcts in the spleen or from extension of suppuration about splenic infarcts to the overlying peritoneum.

The Spleen was found enlarged in 70 per cent. of my cases, and could usually be demonstrated by percussion, but rarely by palpation. Swelling of the spleen in children is one of the characteristic signs, and the organ is frequently painful on pressure. In one of my cases a considerable part of the left side was painful, and in a second case pain over the spleen was severe and localized. Vogel demonstrated splenic tumor 606 times out of 662; it was palpable 36 times in 101 cases. Henoch found splenic dulness in 140 cases, and Filatow speaks of splenic tumor as one of the cardinal symptoms of typhoid in children. He says that it usually can be demonstrated about the fourth or fifth day—that it is absent in only 10 per cent., and can be palpated in about half the cases.

The Liver may and probably does preserve its normal condition throughout the great majority of typhoid attacks. I have personally noticed no changes, and mention in literature is rare.

The Kidneys maintain their function remarkably well. Urine is sometimes scanty in children, and micturition somewhat painful. The value of Ehrlich's test is perhaps not so important in children as in adults, inasmuch as the reaction occurs in miliary tuberculosis and other diseases in children. Albuminuria, either as a result of the fever or during convalescence or associated with acute Bright's disease, will occur in rare cases.

Epistaxis.—This symptom will be observed in a fair proportion of cases. It was slight in several of the cases I have seen, and severe in a few. Vogel remarks that nose-bleed in typhoid in children is rare.

Laryngitis is rare, but is found in a few cases. In a little patient under observation at this time it is present to such an extent that there is complete aphonia. It will be unimportant in this case, but it may in other instances develop into a formidable symptom. Post-typhoid necrosis of cartilages of the larynx is far from uncommon. Vogel says that inflammatory conditions of the cartilages may take place, and Henoch reports 4 cases of laryngeal ulcerations.

Bronchitis is found with considerable frequency, and pneumonia followed by gangrene of the lung is recorded by some authors.

Hypostatic Congestion—by which is meant a state in which a portion of the lung, usually the base, is congested, dense, and unaërated—is liable to be present in all long-continued cases, unless great care is exercised in causing the patient to change position from time to time.

Headache, with its peculiarities, which is so pronounced in the adult, has already been noticed in the general history of the disease. In the flushed face and injected conjunctiva we certainly have evidence of it in children, to what extent, however, it is difficult to say. In mild cases there seems to be but little disturbance of the nervous system, while in the severe form symptoms are very pronounced and meningitis is simulated.

Continued crying took place with some of my patients, especially at night. There were also jerking of the muscles, grinding of the teeth, and stiffness of the neck, particularly among the very young. Delirium and hallucinations were rare, although in a few of my cases delirium was very severe, and convulsions took place in two instances. In one case which I have had under observation recently delirium, especially at night, was very marked at the end of the third and the beginning of the fourth week. This boy, aged twelve, talked and yelled, refused to take his nourishment, picked his nose and eyes, making them bleed to such an extent as to require his hands to be tied. In a second case, during the third week the delirium was so severe and the apathetic and indifferent condition so marked that the little girl, aged five, pulled nearly all of the hair from the top of her head, leaving it absolutely bald. She tore the bedding and clothing with her teeth and filled her nose and ears with the fragments. She tore every button from the front of her night-clothes, and would chew everything that she could reach with her mouth. Both of these children made a good recovery.

Speech was absent in one case for five weeks, and in a second for two weeks. Recovery in one was sudden, while in a second and third it was gradual, and, indeed, it seemed to be necessary to teach these children to talk. Henoch speaks of complete aphasia in 15 cases, and says that it always occurs at the commencement of the remission of the fever. This does not agree with my observations.

Hearing in one of my cases was completely lost for three weeks; recovery, however, was perfect. Otitis media suppurativa of a very offensive character was present in one case in which the nervous phenomena had been extremely pronounced during the early part of the disease.

Sight is interfered with rarely, yet Henoch reports 2 cases of amblyopia.

The Memory is impaired in a few cases, but all under my observation have recovered.

Paralysis is rare, although one case is recorded.

The Pulse.—In the cases which have come under my observation more recently the pulse has ranged from 90 to 180, usually keeping pace with the temperature tracings. This corresponds with the observations made by Henoch. Filatow says that the pulse is slow in comparison with the fever, and that this is more marked the older the child. A slow and irregular pulse indicates some meningeal complication.

Pericarditis occurs very rarely, while endocarditis takes place with slight additional frequency.

Phlebitis occurred in one case, the affection making its appearance in the profunda femoris vein.

Arterial Stenosis has occurred in a recent case of mine, not, however, in a child, but the symptoms were so peculiar and the pathological findings so remarkable that it appears to me important to mention the complication.

Periostitis was observed in one case, the parietal bone being involved.

Cellulitis takes place occasionally, and can usually be traced to some infection by the patient. In one case, the history of which I have preserved, a septic cellulitis in the forearm, followed by diffused abscess, was caused by infection from the finger-nail of the patient.

Bed-sores occur occasionally, notwithstanding all care that may be taken to prevent them. Dr. Hare says that the occurrence of bed-sores is a sign of a poor doctor. It appears to me, however, that in some cases—where prostration is great, the powers of life poor, and the conveniences for avoiding this complication limited—it will take place.

Sepsis from a collection of pus in the middle ear has not, to my knowledge, been mentioned. It is believed to take place, and from observations recently made it appears that we should inspect the drumhead from time to time in order to acquaint ourselves with its condition.

The Facial Expression appears to me almost pathognomonic. It sometimes seems that, with a history of the fever and the appearance of the face, we have enough to diagnosticate the disease. And later in the course, as we look at the flushed cheek and the almost insensible appearance of the patient, with half-closed eyes, a dried tongue, a mouth full of sordes, with absolute unconsciousness of surroundings, and with a perfect indifference to the ordinary wants of nature, we appreciate, as we do in hardly any other disease, what we intuitively call the "typhoid condition."

Post-typhoid Pains take place in a considerable number of cases. In the first of which I have a record the pain was so severe in the thigh as to suggest an osteomyelitis. In another case severe pains were present in the chest; in a third, in the left arm and upon the left side of the chest, persisting several days. In a fourth case severe pains of a general character followed a relapse, and in another pains were located for many days in the shoulders and feet.

Relapses take place in a fair percentage of cases, notwithstanding all the care taken to prevent them. The duration of these relapses has been from fifteen to twenty days. The fever is less severe than in the preliminary attack, the temperature usually marking from 102° to 103.5° F. A considerable number of the primary symptoms will be present, such as epistaxis and diarrhœa. According to one observer, there were in 670 cases 65 relapses.

Post-typhoid Temperature.—There is a rise in the temperature in many cases after it has remained normal for one or two weeks. It increases from one to three degrees above normal, and usually seems to have been brought about by some error in diet, by fatigue, or constipation. This exacerbation usually subsides in about a week.

Diagnosis.—The diagnosis of typhoid fever in young children is frequently attended with difficulty. Trivial complaints, from slight indigestion and worms to the most dangerous general diseases, such as acute tuberculosis, have been confounded with the malady under consideration. In general, during the first week watch for local processes as the cause of the fever and exclude the eruptive diseases. By the end of the second week rose-spots will frequently have made their appearance, and the symptoms referable to the gastro-intestinal canal will be quite pronounced. All local and eruptive diseases may now be certainly excluded. Influenza, also, may at this time be disregarded.

With the history of the first and second week in mind, by the end of the third week the observer will probably have the majority of what I may designate as the cardinal symptoms to consider, *i. e.*: 1. Headache with an indifference to external surroundings and with an apathetic expression of the coun-

tenance; 2, fever, more noticeable at night; 3, gastro-intestinal disturbances; 4, rose-spots. It is not necessary that all of these symptoms be present, but they can be mentally discussed. Some will have been present and disappeared, others will be noticeable. By the end of the third week, if neither splenic tumor nor rose-spots are present, we should at least bear in mind the possibility of tuberculosis.

Malarial fevers, as they occur in children, simulate many of the symptoms found in typhoid. I am not at all surprised that for years intelligent physicians have confounded the two diseases. The fever and hebetude in an infantile remittent are very much like those which we find in typhoid; but as time goes on and we notice the tendency to hæmorrhage, the intestinal disturbances and the rose-spots, it appears to me that we should have but little trouble in excluding this disease. The effect which quinine has on this class of diseases will have its influence in diagnosis.

Typhus fever, as it occurs in other countries and affects particularly children, is regarded difficult to differentiate. The rapidity of all the symptoms, particularly the rise in temperature, the development of the disease as a whole in a few days, so different from typhoid, and the peculiar eruption, will usually enable the physician to make his diagnosis.

Influenza, or "la grippe," in many instances has such gastro-intestinal disturbance as to simulate typhoid fever. In my judgment, we do not get the prostration in typhoid as early as in influenza, and the organs are earlier involved in la grippe than in typhoid. The entire disease (influenza) will have exhausted its fury, either on the gastro-intestinal canal, respiratory apparatus, or nervous system, by the time a typhoid is fairly developed; and it is not usual for such unexpected and rapid changes in temperature to take place in typhoid as we find in the other disease.

Meningitis, either simple or tubercular, is a disease which will seriously tax the diagnostician in differentiating from typhoid. In meningeal diseases there are usually vomiting at the onset, violent and excruciating headache, and fever, particularly in the acute form. In this form, however, the invasion is very rapid. The pulse, too, is usually slow and irregular in meningeal disease, and the tendency to sleepiness and coma appears earlier than in typhoid. In typhoid fever tympany is usually present, while in meningeal diseases we expect a retraction of the abdominal walls, and later the boat-shaped or scooped-out appearance of the abdomen. In tubercular meningitis the previous history of the case, the family history, and its slow progress will usually determine the difficulty. Advantage might here be taken of a suggestion of Georgevitch, to puncture the spleen and make cultures of the blood thus obtained, in order to determine the presence or absence of the bacillus of Eberth.

Chronic gastro-intestinal catarrh is another disease from which typhoid must be differentiated. The history of the case, with attention to the temperature range, and the absence of rose-spots and splenic tumor, will usually lead us in the right direction.

Empyema is a disease which has been confounded with typhoid fever. It would seem, however, that a thorough examination of the chest would establish the case. The fever, the slight cough, the want of appetite, and the slightly increased respirations are all symptoms which we find in typhoid, but the discovery of flatness over a considerable amount of chest-surface should determine the diagnosis without very much trouble.

Prognosis and Mortality will be different in different epidemics. The percentage of deaths is much less than in former years, and we have every

right to believe that, with the restriction we now make in diet and with the rest we order, the diminution will continue. One authority makes it 14 per cent., and one as low as 5. In 20 cases among children which I have recorded during the past two years not a death took place. Several years ago, when we were having sporadic cases, I had a death from perforation, and later another from exhaustion and hæmorrhage. Dr. Forchheimer of Cincinnati in the epidemic of 1888 treated seventy cases without a single death.

Treatment.—There are a few cardinal principles in regard to the general management of typhoid in children which must be observed throughout the entire disease. The first is rest in bed; second, a restriction to fluid diet; third, attention to temperature and intestinal antisepsis; and fourth, the administration of a general nutritive tonic.

The treatment of symptoms—that is, something for the liver to-day, and some other drug to stimulate or diminish the activity of the kidneys to-morrow, or a little aconite or belladonna for the fever, or something for the tongue—seems to me, to say the least, unnecessary. Many who are treating typhoid in this manner fail to comprehend the salient feature of the disease, which should be constantly in one's mind.

Prophylaxis and Hygiene.—It goes without saying that children with typhoid fever should be separated from not only other children, but also the family, and that all communication between the sick and those uninfected should be as rare as possible. All water and milk should be thoroughly sterilized, and the room in which the little patient is sick should be light and airy, and should be so arranged that easy and thorough ventilation is possible. In the introduction of fresh air the patient of course should not be exposed to direct currents.

All dejections should be thoroughly disinfected, either with carbolic acid, the bichloride of mercury, or the sulphate of copper, or, what seems to me equally good and easily prepared, a thin mixture of ordinary lime. If the above very direct suggestions could be carried into effect, we would diminish the cases of typhoid fever we are obliged to treat: and I am firmly of the belief that a certain number of cases can be aborted if, in addition to prophylaxis and hygiene, we would early put our patient to bed, give a fluid diet, and possibly some intestinal antiseptic.

Rest in Bed.—This must be absolute, and should commence as soon as we suspect the disease, and be continued, without interruption or concession, until the patient has been from four to ten days without elevation of temperature. I place this among the cardinal points of treatment, for I believe that many cases have gone from bad to worse simply because the physician has not insisted upon the rest which I have suggested. Children who are fairly well advanced in typhoid should be kept where they are, rather than sent to hospitals or removed, if at any distance, to their homes. I believe it is not good practice to remove patients, yet sometimes it seems absolutely necessary, and may be accomplished without detriment, although in other cases a removal, even for a short distance, has seemed to retard recovery or even produce a fatal termination.

Diet.—Instructions in regard to fluid food should be explicit, and from these directions there should be no deviation, no half-hearted concessions. The food I direct is usually milk or its equivalent in some fluid form. It is just possible that occasionally a larger amount is taken into the system than can be properly cared for, and that those undigested masses of caseine and fat which are sometimes found in the dejections may be responsible for the unreasonable persistence of fever sometimes noted. Children from two to five years of age

may take from a pint to two quarts of fluid food a day. If it disagrees with the stomach or if they insist upon some change, add lime-water, seltzer, or ordinary pop; or the milk may be skimmed or predigested. If milk is not relished, mutton-, chicken-, or oyster-broth or beef tea may prove acceptable. Koumyss is relished by many of these little people, and agrees with them comparatively well. If beef tea is to be used, let it be prepared as follows: Put a pound of beef, cut into small pieces, into a pint and a quarter of cold water, and allow it to stand for one hour, at the expiration of which time place it over a fire and let it evaporate slowly to ten or twelve ounces. In my judgment, this is a much better beef tea than is usually obtained at the drug-stores. The egg-water which I have suggested so many times in other diseases is frequently well taken by these little people at this time: Take the white of one egg, an equal amount of sterilized water, a little sugar, and 10 or 15 drops of whiskey or brandy; agitate sufficiently to thoroughly mix, but not form a foam. This is not only nourishing, but is relished exceedingly well. The liquid peptonoid is a palatable food, and possibly has some medicinal properties. Usually, then, with milk or cream properly diluted, the various preparations of the animal broths, koumyss, and the egg-water, a sufficient nutrition is provided for these patients. When, after four or five weeks of fever, two days have elapsed without rise of temperature, I allow a small amount of cream- or milk-toast. In two days, if this does not disagree with the patient by producing gas and uncomfortable sensations in the digestive tract, I allow the child a baked potato with plenty of butter. If, with the addition of the cream- or milk-toast and the baked potato and butter, there is no increase in temperature for ten days, the patient is allowed to sit up for a short time and commence to chew beefsteak or mutton-chop. Before this I sometimes allow the red juice from the roast beef or a little beefsteak juice, expressed with a lemon-squeezer. From this time forward there should be a slight increase in the amount of food allowed each day until the patient is upon a diet sufficient to nourish him. I need not say that to maintain a child upon a fluid diet for all of these weeks, in the face of its importunities and those of its parents, is difficult, but it must be insisted upon. Whenever I have encountered a relapse, it has usually come from errors in diet.

Bathing.—A moderate degree of fever is not to be dreaded, and unless it goes to 103°, I am not in the habit of administering any antipyretic remedy. I control the temperature by cool baths when the children do not oppose it in a great degree. It will, however, be impossible in private practice to carry out in detail, in all cases, the Brand treatment as used by the Germans or the Bouchard treatment as suggested by the French. It will be well, however, to take advantage of a full knowledge of these methods, and then vary them as the condition of the child seems to demand. It will be practicable, in most cases, to reduce the temperature by placing cold towels over the child, rather than to put it into the full-length bath. Under the direction of a competent nurse the temperature in such cases will be reduced without much trouble.

Medicines.—Rest, a fluid diet, and cool bathings are all that is needed in the treatment of many cases of typhoid in children. Medicines, however, are useful in some cases and for some symptoms. They give comfort to the patient, and modify what might become a dangerous and serious complication. I have noticed at another place in this article that with rest and a fluid diet and some intestinal antiseptic, probably the bichloride of mercury, some cases of mild typhoid fever are really aborted. Sometimes there seems to be a malarial element in a case, in which event quinine in moderate doses may be administered for a few days. Quinine should usually be given in the forenoon

and exhibited in either syrup of licorice, yerba santa, or chocolate tablets; inunctions are useful for the very young. In case it is suspected that the fever is of malarial origin, the administration of a laxative to clear out the alimentary canal as completely as possible early in the disease would certainly be advisable. Early in the disease I am in the habit of prescribing a general tonic, or, what is a better name, a restorative medicine, which in many cases is persisted in from first to last. A great array of medicines is entirely useless. Combinations will have to be made from time to time, but they should call for small amounts and be made as palatable as possible. The restorative medication to which I have already referred is made up somewhat after the following formula:

℞. Pepsin cordial . . . . . f℥ss.
Compound syrup of hypophosphites . . . . . gtt. xv.
Aromatic sulphuric acid . . . . . gtt. j–iv.
Aromatic water . . . . . q. s. ad f℥j.

A dose of this combination is given four times a day. When there is constipation I usually substitute muriatic for aromatic sulphuric acid.

In addition to the general directions in regard to the diet, rest in bed, and the administration of the restorative medicine mentioned above, orders are given to sponge the surface of the body with tepid water in case the temperature goes to 103°. Sometimes a preparation of phenacetin is prescribed, with instructions to give an appropriate dose if the temperature goes to 103.5° or 104° and is not reduced by the cold bath.

I can state with definiteness that from 2 to 3 grains of phenacetin given to a child from eight to ten years of age with a temperature of 104° will reduce it almost without a doubt to 100° or 100.5°. I have tried this many times, and can speak with confidence. This, in my judgment, is the best remedy at our disposal if we must administer a drug for the reduction of temperature. I have never had the success with administering the large quantities of quinine that some of my colleagues have had. I think that large doses of this remedy in the midst of typhoid fever are sometimes harmful.

Intestinal antiseptics probably stand next in importance to antipyretics, and perhaps should even take a precedent rank. The toxine or poison formed or made more malignant in the system during the course of the disease is coming to be a question of very great importance. It has seemed to me that a full dose of some of the salines or castor oil at the onset of the disease was in many cases really indicated, but, as I shall say at another place, it has not been my custom to administer these cathartics. Of the intestinal antiseptics, salol, thymol, naphthaline, the salicylate of bismuth, the mercurials, and turpentine are among the best at our command.

Treatment of Individual Symptoms.—For the headache, delirium, and restlessness which are present in many cases bromide of potassium, either alone or in combination with chloral, gives the best results. For a child four years of age I order 4 to 6 grains of potassium bromide and 2 grains of chloral hydrate in syrup and water. In severe cases phenacetin may be given, or, if the prostration is not great, 2 grains of antipyrine and 6 grains of potassium bromide in syrup and water. For the aphthæ and different forms of stomatitis, potassium chlorate, with carbolic acid in combination, will be found useful. For the vomiting, bismuth subnitrate, with carbolic acid, made up somewhat after the following formula, nearly always has a good effect:

℞. Bismuthi subnitratis . . . . . ʒj.
Acidi carbolici . . . . . ♏ij.
Glycerini . . . . . fʒiv.
Aquæ . . . . . q. s. ad fʒij.
Sig. Shake and give one teaspoonful every two or four hours.

After convalescence is established and some appetizer is indicated, pepsin, a mineral acid, and nux vomica may be used:

℞. Pepsini saccharati . . . . . ʒj.
Acidi muriatici . . . . . gtt. viij.
Tr. nucis vomicæ . . . . . gtt. xvj.
Vini xerici . . . . . fʒiv.
Syr. aurantii . . . . . q. s. ad fʒij.
Sig. Give a teaspoonful diluted with a little water before meals. Syr. hypophosphitum comp. can be administered in this mixture.

When a remedy for diarrhœa is indicated, nothing, in my judgment, is better in typhoid fever than the following combination:

℞. Olei terebinthinæ . . . . . fʒss.
Acid. sulphurici aromat. . . . . fʒj.
Syr. acaciæ
Aq. menthæ piperitæ } . . . . . q. s. ad fʒij.
Sig. Dose, one teaspoonful.

A few drops of any anodyne may be given with each dose if needed, or a little tincture of geranium if the diarrhœa is very troublesome.

For the relief of the constipation which is persistent in many cases enemata should be given every second day. I am not in the habit of advising laxatives or cathartics after the first week, except in rare instances.

For the tympany any of the saline preparations or intestinal antiseptics may be used, but asafœtida has certainly given the best results. A small amount of the tincture in water or the mistura asafœtidæ of the Pharmacopœia may be used. In some cases the patient may be placed in the knee-elbow position when enemata are given. The hæmorrhage of the bowels is best treated by absolute quiet, the ice-bag, and elevation of the lower extremities. It is possible that ergot with some astringent may be beneficial.

If perforation takes place, in addition to the above the question of laparotomy should be considered. It is so difficult to find the opening, and the patient is frequently in such collapse before the operation can be performed, that the advisability of such a course is in my opinion not fully established. Possibly as many lives are saved without as with the operation. Peritonitis should be treated by rest, hot applications, and opium.

The liver is involved so infrequently that medication is hardly necessary. The same may be said of the kidneys, although sometimes I am in the habit of ordering additional water, and sometimes a few grains of the citrate of potassium.

For epistaxis, cold to the nose and the insufflation of some of the astringents should be used. The bronchitis is best relieved by the usual cough mixtures into which a small amount of ipecac, paregoric, and muriate of ammonium enter. Hypostatic congestion should be prevented by frequent changes in position and by the administration of stimulants.

Impairment of the special senses is usually relieved by attention to the general nutrition, which is brought about by diet and tonics. A discharge from the ear should be treated with absolute cleanliness and the use of antiseptics. It is not necessary to pay much attention to the pulse in the early history of the disease, and I am not aware that aconite and its substitutes are of any benefit. Later in the disease digitalis, or, if the pulse is very weak and rapid, nux vomica and the ammonia preparations, may be demanded. Keep the patient absolutely in the recumbent position, and add alcoholic stimulants to the above remedies. Indeed, there is a time in some cases of critical typhoid in children when some form of alcoholic stimulant, freely administered, seems to carry the patient from the most desperate and dangerous condition to one of safety. Such local manifestations as periostitis and cellulitis are best treated with the wet boric-acid dressing.

EPIDEMIC CEREBRO-SPINAL MENINGITIS.

By ROLAND G. CURTIN, M. D.,

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Synonyms.—Epidemic meningitis; Fever with cerebro-spinal meningitis; Meningeal fever; Petechial fever; Malignant purpuric fever; Spotted fever; Cold plague.

Definition.—Epidemic cerebro-spinal meningitis is a specific infectious fever (probably of microbic origin) in which the poison seems to have a special predilection for the meninges of the brain and spinal cord. It attacks the young with greater frequency than any of the fevers outside of those belonging especially to childhood, and with more severity than any of the continued fevers. The onset is abrupt (without prodromes). The prominent symptoms are chill, more or less marked; vomiting; headache; delirium, generally present in the first and second day, later stupor and coma; pains, muscular and neuralgic, in trunk and limbs; stiffness or contraction of the muscles of the neck, rarely lower down the back—all of which symptoms indicate inflammation of the meninges of brain and spinal cord. Recovery may be quite rapid, when the disease is of short duration and the nervous system is not seriously affected. In most cases, however, recovery is exceedingly slow. Death is common among children, especially in severe epidemics. The immediate causes of death are convulsions, kidney complications, exhaustion, bed-sores, and abscesses or gangrene.

If epidemic cerebro-spinal fever occurred prior to the commencement of the present century, it was not recognized as a distinct disease. It was first discovered in Geneva. In America the first reported cases occurred in Medfield, Mass., in 1806, and since that time it has occurred in frequent epidemics in different parts of North America, and in fact it is reported as an irregular epidemic visitor in all parts of the world. A sporadic form of cerebro-spinal fever is recorded yearly in the mortality statistics of all the larger cities of the United States: in studying the death-reports it must be acknowledged and remembered that some physicians call simple acute meningitis and other meningeal forms of disease, especially the continued fevers and tubercular meningitis, by the name of cerebro-spinal fever.

Etiology.—The specific cause has not been positively determined. There are physicians who have announced the discovery of a microbe similar in appearance to the pneumococcus, but it has not been satisfactorily proved that this is the specific causative germ. However, it is generally conceded that the disease is of microbic origin.

In a New York medical society meeting recently a physician stated that he had made autopsies upon 3 cases of so-called sporadic cerebro-spinal fever, and found specific germs of other diseases, all different. One had the typhoid fever germ without intestinal evidence of the disease. I am of the opinion that

when we perfect our bacteriological knowledge all these sporadic cases will be found to be due to infection of the brain and spinal cord by germs that usually affect other tissues.

Epidemic cerebro-spinal meningitis is an infectious disease, and it is questionable whether it is contagious or not. Widely-separated districts are simultaneously visited by epidemics, and over extended districts isolated individuals are attacked at the same time; so that the idea of its being transmitted by direct contact in these cases is untenable. Owing to the fact that this disease has followed epidemics of influenza, and on account of the many points of similarity in the two affections, Drs. Job Wilson and J. J. Levick have been led to suppose that there is some connection between the two diseases. It is more common in the winter and spring than in the summer months; hence the name "cold plague" has been given to it. Slight injuries, especially to the head, fatigue, exposure to cold, and mental depression are exciting causes.

Pathology.—In the early or congestive stage nothing is found in the brain and spinal cord except a congested condition of the meninges; the blood-vessels are enlarged and gorged with blood of a dark color; later, after exudation has taken place, the serous plastic exudate is found, especially upon the pia mater. In some malignant cases the exudation is found to be sero-purulent. The lungs are observed to be in a state of hypostatic congestion: where lung complications have preceded death we find evidences of croupous or catarrhal pneumonia, and not infrequently inflammation of the pleura and pericardium. Parenchymatous inflammation of the liver has been noted by some writers. Congestion and sometimes an inflammatory condition of the kidney are found. The heart is flabby, and the blood in malignant cases is frequently observed in a fluid condition. The dusky spots or mottling that are occasionally encountered in malignant cases may be found in all the internal organs as well as on the skin.

Symptoms.—The first symptom generally noticed is a chill, which may be a slight creep or a profound rigor; this usually comes on without any warning, and generally in the later part of the day; it sometimes follows fatigue or perhaps exposure to cold, and occasionally follows injuries to the head. Some cases are stricken down suddenly, as if by a blow, without any previous warning. Headache is one of the most constant symptoms; it is not always an indication of the gravity of the disease. The pain is almost always frontal, generally located between the eyes, and quite often spoken of as bitemporal; it is not infrequently located in the occipital region. It is sometimes excruciating, causing the patient to cry out and toss about; at other times it is a dull, heavy ache. It is sometimes intermittent, at others constant; it may be fixed or lancinating. The pain in the head seems to be the cause of one of the prominent facial symptoms—viz. knitting of the eyebrows. An attack may be ushered in by a convulsion, or by a sudden giddiness, causing the patient to have a staggering gait; this giddiness may only be present while the patient is sitting or standing, or may continue after assuming a recumbent position. This symptom is sometimes complained of throughout the disease.

Delirium is rarely absent; it is more apt to be noticed early in the case, extending through the stage of congestion and sometimes through the whole of the inflammatory stage; it is exceedingly variable; it may be wild excitement, terrorizing, playful, or sombre. The child may continually mutter or now and then cry out. Delirium is especially common in children, and may indicate the gravity of the disease. Coma almost invariably precedes death, and is always to be considered a grave feature; coma vigil is a serious ataxic symptom, in which the patient lies on his back, chin raised, eyelids widely separated,

apparently regarding fixedly some object above the head of his bed, and is accompanied by constant jactitation.

The headache, as before stated, often gives the appearance of great suffering, the brows being knit, especially when the patient is aroused; the cheeks are often flushed early in the disease, but not always so; later the face is frequently pale. In some rare cases the flush is not to be seen at any stage of the disease. In some patients the features are swollen and of a dull, dusky, purplish hue. Strabismus is more frequent in children than in adults.

Spinal pains are quite common, the pain being in the back of the neck, sometimes extending down to the lower end of the spine. Pressure and movement have the effect of increasing the suffering; the limbs and trunk are sometimes very painful: the pain may be of neuralgic character, radiating from centre to periphery, and may attack one set of nerves, and remain constant or change to other nerve-trunks or groups. Local muscular pains and soreness are not infrequently present.

Tonic spasms give rise to tetanoid symptoms, such as opisthotonos, pleurosthotonos, emprosthotonos: the former is the most common, the head being drawn back and the spine curved backward, so that the patient's body is sometimes supported by the occiput and heels. Forced movement increases the spasm as well as the spinal pains. In many cases these muscular spasms are a simple stiffness of muscles or groups of muscles.

Clonic spasms are frequently met with. Subsultus is one of the common symptoms, sometimes amounting to a violent agitation; more commonly it is simply a twitching, and may be the forerunner of convulsions; this symptom is sometimes present before the inflammatory changes in the nervous system are sufficiently developed to produce it; hence the reasonable supposition that it is a result of the irritation produced by the blood-poison.

Paralysis occurs as a result of a loss of nerve-power, which may be caused either by central trouble or by inflammation of the trunk of the nerve supplying the part. These paralyses are sometimes temporary, at other times long continued or permanent. Sudden loss of hearing or sight usually comes on at the time the effusion takes place. Strabismus is especially common in children, and is often a precursor or an associate of convulsions. The conjunctivæ are quite frequently congested; at other times this symptom is absent, especially in the milder cases. In almost every case where there is kidney complication the conjunctival congestion is associated with a purulent secretion, which then becomes quite diagnostic. The pupil varies greatly; early in the disease it may be found to be dilated or contracted, but it is generally dilated. In cases with coma and convulsions it is almost invariably dilated. Photophobia is especially common in children.

The effect of the blood-poison upon the kidneys is to produce a catarrhal inflammation in these organs similar to the catarrhal troubles found in other organs.

The respiratory apparatus is involved in the disease, and some of the fatal complications are seated in the lungs. Respiration is exceedingly variable. Early in the disease it is likely to be hurried, and at times, later on, it may be exceedingly slow; it is sometimes interrupted or jerking, and the Cheyne-Stokes variety is not infrequently seen in the later stages of fatal cases. This latter is not so grave a symptom in the case of children as in adults. In some instances death occurs suddenly from paralysis of the muscles of respiration. Pleurisy, pneumonia, and bronchitis are complications which may occur at any time during the course of the disease.

In exceedingly malignant epidemics there is a dusky mottling of the skin

and the internal organs, the color being purplish; whence the name of "spotted fever" often applied to the disease. These spots (which are oval in shape) are usually from one-third to one-half an inch in their longest diameter. I have seen them on almost every tissue or organ, external and internal, of the body; after death they may be of a slate-color with a chocolate tinge, or quite black. I had an opportunity in 1864 of seeing 14 cases of epidemic cerebro-spinal fever, 4 of which died; 2 out of the 4 cases had these spots. In the Philadelphia Hospital epidemic I saw over 200 cases: the mortality was 43; of the fatal cases, 2 had these mottlings; one of them was the first case that occurred, and died after fifteen hours' illness. About sixteen years ago I was called in consultation to see two young girls near Point Breeze, Philadelphia; they both had these mottlings; one died in twenty-four, the other in thirty-six, hours. At the time only one other suspected case had occurred in the neighborhood; this also was a malignant one. The two girls had visited the abode in which this patient died.

Aside from the mottlings, there is nothing else that seems characteristic of this disease in connection with the skin. Cutis anserina, simple erythema, rubeoloid eruption of a bright cherry-red color in sthenic cases (darker in the adynamic), dermatitis, miliary eruptions, herpes, petechiæ, and ecchymoses, have all been noticed. Hyperæsthesia is one of the most characteristic symptoms; the skin is sore to the slightest touch, and at times the pressure of the bed-clothes is sufficient to produce great discomfort. Anæsthesia of the skin has also been observed; it may be a simple numbness, at other times a positive insensibility. In some cases the skin is found to be very hot; in others it may be quite cool; and occasionally the patient is drenched in perspiration even when the symptoms are not of a grave nature.

The temperature of cerebro-spinal fever is exceedingly varied, so that in a group of cases in the same epidemic it is quite dissimilar. The local inflammation causes changes which prevent anything like uniformity. In the explosive form, the so-called fulminant variety, it may be below normal; in all others there is more or less elevation. In some instances, early in the disease, the temperature is not very high, and in others it rises to a high elevation after the chill. When the local inflammations occur it is generally higher. In children at this stage it is usually from 100° to 101°. The diurnal variation is less than in typhus or typhoid fever. A sudden fall or rise of temperature almost invariably ushers in serious symptoms: in fatal cases it has been found at the time of death to be as high as from 107° to 110°.

The pulse in cerebro-spinal fever in children is usually quite rapid; in adults at the second and third stages of the disease it may be abnormally slow. The difference is owing to the modified nerve-influence which the disease is prone to exert.

Complications.—Among the complications observed in this disease may be mentioned pleurisy, pericarditis, endocarditis, parenchymatous degeneration of the liver and kidneys, and intestinal catarrh. "Œdema, hypostatic congestion of the lungs, bronchitis, atelectasis, and broncho-pneumonia are not uncommon lesions in cerebro-spinal meningitis" (Welch).

Sequelæ.—Parotitis; gangrene; furuncle; abscesses; muscular and mental weakness; epilepsy; impaired nerve-power, sometimes amounting to paralysis; general or special persistent emaciation; and, in children, effusion following the inflammation of the membranes of the brain sometimes results in chronic hydrocephalus. Dr. Chas. K. Mills, in a paper read before the Philadelphia Neurological Society in March, 1888, called attention to the occurrence of multiple neuritis as a complication of this disease, and also suggested that multiple neuritis might be the only result of the same infection that causes the meningitis.

Diagnosis.—In the earlier stages, especially in children, it may be mistaken for scarlet fever. This is true where there is a general erythema or dermatitis. The existence of the epidemic influence of either disease or the presence or absence of severe throat symptoms will greatly assist in the diagnosis. The redness of the skin coming on in epidemic cerebro-spinal fever generally appears later than that of scarlet fever, in which it usually happens in the first twenty-four hours. The eruption is quite transitory, and is not, as a rule, followed by desquamation or itching.

The abrupt onset and the greater activity of the symptoms, the absence of tubercular manifestations elsewhere, the rarity of eruptions and extreme muscular contractions, the slow regular course, and the higher temperature would distinguish epidemic cerebro-spinal fever from tubercular meningitis. The absence of exciting causes, the extremely faint muscular spasms, and the sensitiveness of the skin, all help in distinguishing it from simple or secondary meningitis.

The muscular spasms and general and muscular pains usually distinguish this disease from ordinary cases of pneumonia, typhus, and typhoid fever; but in the meningeal forms of these diseases it is extremely difficult to make a diagnosis, though the sudden onset with meningeal symptoms will greatly assist. The earlier symptoms should be studied to find out whether there were evidences of pneumonia or any other previous disease. Abdominal symptoms occurring early might suggest typhoid fever. The eruption of typhus is the distinguishing mark in that affection. Rigidity of the muscles, present in cerebro-spinal fever, is absent in the preceding diseases. I have known mistaken diagnoses to be made in cases of small-pox in the earlier stages.

Prognosis.—This is always grave in children, more so than in adults. When we take into consideration the extreme susceptibility of the nervous system of a child, we can readily see how dangerous this disease is during the earlier years of life. Prognosis in adults is a difficult task, for in simple cases sudden grave complications sometimes present themselves later in the disease, and, on the other hand, a case with the severest early symptoms may be followed by speedy convalescence. It is a disease in which it is impossible to estimate the complications which may arise.

Unfavorable signs are profound coma; low typhoid symptoms; uræmia; great blood dyscrasia, shown by marked ecchymosis; continued convulsions and prolonged high fever. Protracted cases are likely to be followed by fatal exhaustion.

Treatment.—The types and lesions of the disease are so various that the details of the treatment are exceedingly difficult to formulate to meet all cases.

The prophylactic treatment consists in careful attention to sanitation, as the disease is invited by uncleanliness of person or surroundings; the same is true of over-crowding. Exposure to heat or cold, and fatigue, either bodily or mental, are favorable to the onset of the disease. Children in a locality where the affection is prevalent should be furnished with fresh, nourishing, and easily-digested food; they should be isolated from the sick, and should have plenty of sleep and pure air. Clothing from about the sick should be destroyed or carefully disinfected. The weak, old, and nervous should be removed from infected localities.

Almost every remedy in the medical category has been tried to abort this disease: bloodletting has had its votaries, and others have highly extolled the virtue of mercurials in the earlier stages; emetics, again, have been recommended, but all have largely been abandoned. The plan pursued by most recent authorities is to treat the disease symptomatically.

In the first stage we have a congested condition of the meninges of the brain and spinal cord: the indication is to aid in the reduction of the quantity of the blood in the meningeal blood-vessels; first, for the purpose of relieving the symptoms, and, secondly, to reduce the inflammation and modify the inflammatory products. One of the difficulties of administering medicine by the mouth is the common symptom of vomiting, which is sometimes very persistent. Venesection should not be practised in children. Some of the German writers use early local bloodletting by wet cups and leeches. Dry cups to draw blood from the internal congested vessels without removing it from the body are of great value. The external application of cold to the head by ice, ice-water cloths, cold-water cloths, is useful, and some have used hot baths to the body, hoping to draw blood from the centre to the periphery. Hot mustard foot-baths can be used with advantage to relieve the pain in the head and back. If the stomach should bear it, potassium bromide and ergot may be administered; if not, the former may be given by enema, the latter hypodermatically, for the purpose of favorably influencing the capillary congestion. For the pain in the muscles the antipyretics have been used; phenacetin is probably the safest and best of all. It should be used in small, frequently-repeated doses, and its use should be discontinued if the patient becomes weak or exhausted. A mustard plaster, one part mustard to three of flour, placed over the spine, often relieves the pain in that location, and counter-irritation to the nape of the neck diminishes the pain in the head and relieves the delirium. Care should be taken not to raise a blister, which would seriously complicate the case. Liniments over the same region—turpentine or chloroform—may be used for similar purpose. Belladonna seems to afford relief to the neuralgic pains and muscular spasms. Dr. J. M. DaCosta highly lauds the use of hyoscine hydrobromate for the muscular spasms in this disease. For insomnia early in a case chloral may be cautiously used in conjunction with potassium bromide. Chloral sometimes causes cerebral excitement, and when this occurs it should be discontinued. Opium has always been used with the happiest results. It has been recorded that in some cases large doses of opium are tolerated. The salicylates and gelsemium will allay the pains in the trunk and limbs, but will not relieve the pain in the head. A dark, quiet room should be selected for the patient in any stage; this is of great importance where there is cerebral excitement.

In the second stage the exudate is thrown out; it may be serous, plastic, or even sero-purulent; the blood-vessels are dilated and engorged. Absorptive remedies are now to be used. Potassium iodide to produce absorption of the exudate, and oil of turpentine internally have been used late in this stage for the same purpose, with seeming good results. Arsenic and iron are of great use during convalescence to improve the blood. Stimulants, especially for children, should be used with great caution, as an excess will irritate the brain and excite the circulation in either the first or second stage. Hypophosphites, especially with strychnine, are beneficial during convalescence. Cod-liver oil when digested often produces the happiest results. In the later stages of convalescence massage is of great importance to stimulate the circulation in the muscles and nerves. Electricity is indicated for paralysis or weakness of the nerve-trunks. For the same purpose alternate hot and cold affusions to the weakened parts, and exercise, carefully regulated as to time and amount, greatly assist in strengthening the muscles and nerves.

EPIDEMIC INFLUENZA.

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Influenza is a general infectious disease producing catarrhal difficulties of either the respiratory or gastro-intestinal tract, or painful symptoms referable to the nervous system. In addition to the symptoms thus indicated, it is attended with prostration out of proportion to the apparent involvement of the organs named, and is liable to be followed by sequelæ which affect profoundly the further usefulness and comfort of the unfortunate victim. This disease has been recognized and described in our country for two hundred and fifty years, the first epidemic occurring about 1647. Other epidemics have taken place from time to time, and have been referred to by writers under different names; but the disease, as it affects us particularly, and its history, as we understand it at the present moment, have come to us in the three consecutive epidemics of 1890, 1891, and 1892. At the time of writing (January, 1893) only a few sporadic cases have taken place during this year, and they have not been severe. We cannot yet speak of an epidemic of 1893. During the period referred to, great attention has been given to the study of the disease by our profession, and, in certain instances, by governmental authorities.

Etiology.—It has not been believed until recently that the causes of this disease are really known. Certain hypothetical causes have been advanced, such as air, contagion, local conditions, general influences, etc. But during the last three or four years very close investigations in regard to its etiology have been made. The reports of the British medical government clearly show that the spread of the disease depends upon human intercourse, and that it spreads no faster than human beings, parcels, or letters can travel.

Bacteriological investigations have been carried on with great accuracy during this time. Filatow wrote fully concerning the history and symptoms of the disease under consideration, and Seifert investigated the bacteriological history three or four years ago; but particular investigations have been carried on during the past year in the Berlin Institute by Drs. Pfeiffer, Kitasato, and Canon; and Sternberg remarks that there is good reason to believe that the bacillus discovered by these investigations is the specific cause of the disease. The following résumé from Dr. Sissley of London gives much regarding the etiology of the scourge under discussion:

(1) The first case of influenza in a town is generally a patient who has come from an isolated place.

(2) Isolated cases precede the epidemic.

(3) Influenza extends along the lines of human intercourse.

(4) Isolated persons, such as prisoners and inmates of asylums and convents, often escape the disease.

(5) The number of those affected in an epidemic increases till a maximum is reached, and then declines, as in the case of other contagious diseases.

There is no doubt that nursing children three or four months of age feel the influence of la grippe. Dr. Townsend of Boston has placed on record a case where the mother had an attack of influenza about the time of her confinement, and the child in a few hours after birth began to sneeze and had all the symptoms of this infection; and an English observer records the case of an infant who died on the third day of its life from this disease. It is somewhat difficult to diagnosticate influenza in very young infants, but it is fair to suppose that, when the infection is present in the house and parents and nurses are under its influence, if infants present unusual symptoms of fever, exhaustion, and the involvement of one of the three systems which are usually selected by this infection, the disease is due to the poison of influenza.

The exact point at which the infection may gain entrance to the system has probably not been ascertained. That it may enter through either the alimentary canal or the lungs there is no doubt, and in all probability these are usually the points of entrance. One observer believes that the conjunctiva is in many instances the structure through which the poison attacks the system.

Influenza and Diphtheria.—The marked similarity between the remote effects of the poisons of diphtheria and influenza is very great, and it is quite possible that the pathological findings in influenza may be quite as numerous and significant as we already know they are in diphtheria. We possibly do not know the exact cause of influenza, but we are certainly warranted in assuming that there is a most profound toxic effect in influenza as well as in diphtheria. The depression is profound, the recovery slow and tedious, and the involvement of the nervous system in both diseases is extremely significant. The action of these two poisons upon the heart is somewhat similar. Every practitioner of experience has noticed the slowness of the pulse and its irregularity, and in some instances death has occurred in such an unexpected manner that we could attribute it to nothing less than degeneration of the heart-muscle.

Pathology.—There are but few special post-mortem findings known to this disease which are of value to us as relating to children. Nearly every study has been based upon examinations made in adults, and the records of autopsies made solely and particularly to find the results of influenza on the tissues of the young are extremely meagre. Ashby and Wright state that "at the post-mortem no grave lesion is found, but there is usually venous congestion and marked injection of the venous capillaries;" and Vargas of Barcelona, whose opportunities for seeing many cases profoundly sick with influenza have certainly been very great, after remarking that rapid deaths are usually due to severe attacks affecting the nervous system, says that while we cannot state that there is an apoplectic form, in some cases the post-mortem revealed the venous plexus congested, and also cerebral hæmorrhages. The same author also asserts that in cases where the gastro-intestinal symptoms predominated there was tumefaction of Peyer's glands and of the solitary follicles.

In 115 references to influenza found in the *British Medical Journal* of 1891 and 1892, not one speaks particularly of the pathology as it is found in children. And in the works of Filatow and Uffelmann, both written in 1892, absolutely nothing is said regarding this part of our subject. The special effects of the poison of influenza upon the tissues of the young have yet to be described.

Incubation.—This may be only a few days, possibly only a few hours, or, on the contrary, the influence of the poison may be felt for weeks before the active development of the disease. Others who have studied the disease believe that two or three days is the usual time of incubation.

Clinical History.—The disease affects more particularly one of three groups of organs: First, the respiratory and circulatory apparatus; second, the gastro-intestinal canal; third, the nervous system.

Sometimes the infection localizes itself in the respiratory tract, spending its energy there, and the patient will pass through a severe catarrhal bronchitis or a pneumonia with such general prostration as to endanger his life; or the disease manifests itself as a catarrhal inflammation of the stomach and bowels, with a tendency to collapse on account of the extreme weakness which is induced; or, closely following the severe headache, which indicates that the nervous system is the first to be attacked, have come threatened convulsions and meningitis. We have these organs affected singly, or in some cases a complication involving almost all of them, such as a bronchitis with gastro-intestinal disturbance, or a gastro-intestinal disturbance with great nervous prostration.

The invasion is rapid, and the disease is frequently ushered in with a chill followed by delirium and rapidity of pulse. The face in many cases is red from the commencement of the disease, and there is earache, vomiting, and an increase in temperature. The fever is not high in the majority of cases, but occasionally an unusually high temperature is noticed. In a majority of cases, at some time during the disease, the temperature is subnormal, varying from one-half to two degrees below the standard of health. This condition of temperature is undoubtedly a result of the action of the poison upon the general nutrition, the imperfect action of the lungs which is present in many cases, and the general depression of the vital forces. There is also loss of weight. This has been particularly brought out by Hansen of Copenhagen, who concludes that, while in some cases there is simply a standstill, in many there is an absolute diminution in normal weight. It is fair to conclude that this evidence of waste—in other words, work—represents the conflict between the poison of influenza and its subjects. In some cases this diminution of weight is noticed when there are no other signs of the disease present. And finally there is a very pronounced general weakness never before experienced by the patient, and in no one organ or system of organs is it more noticeable than in the circulatory apparatus. The pulse is usually accelerated, sometimes very rapid, and the heart, in many instances, never regains its strength and vigor.

Special Features.—*Respiratory Symptoms.*—A catarrh of the respiratory organs takes place with great frequency, and in its various phases extends to every part of this system. Sometimes the upper breathing apparatus is attacked first, and the disease rapidly spreads and involves the rest. The eyes are usually red and suffused, and in many cases not only is the middle ear involved, but disease of this organ remains as a sequel for a long time. A general catarrhal bronchitis is frequently present, and in some instances pneumonia with all its characteristic symptoms. There is in many cases, early in the disease, an apparent localization of the infection in one or both of the lungs, threatening a pneumonia, but this usually clears up in a very short time, and the disease becomes diffused throughout both lungs. Very often there may be only a severe and perplexing cough, without any physical signs. Respiration is sometimes slow, and in a few cases breathing for a few seconds has absolutely stopped. These peculiar paroxysms have been repeated several times during the day, and in a few instances life has been preserved during these attacks only by artificial respiration. Thoracic pains are sometimes intense, and call for the external application of anodynes.

Circulatory Symptoms.—There is usually from the first a rapidity and weakness of the heart, and syncopal attacks occur in many cases. Depression in the action of this organ and failure in its supply of nerve-force seem entirely

out of proportion to all other symptoms. While in many cases the temperature and pulse seem fair, there is an unusual muscular weakness and a tendency to syncope. I have not noticed organic heart disease, but cyanosis has been present in a few cases, and in many instances palpitation and short breathing are not only noticed during the active history of the disease, but also interminably follow its unfortunate victim.

Gastro-intestinal Symptoms.—The tongue is frequently flabby and coated, and shows indentations of the teeth, indicating malnutrition. The appetite is often entirely absent, and persistent vomiting takes place in many cases. Herpes labialis is sometimes noticed, as also sordes. Diarrhœa to such an extent as to become exhausting is frequent; constipation is sometimes present. In some cases the diarrhœa and vomiting are so frequent and persistent, and the child becomes so rapidly collapsed, that if the case occurred in the summer a diagnosis of cholera infantum would undoubtedly be suggested. As the result of this great withdrawal of fluids from the body, the eyes and fontanelles are greatly depressed, and the child becomes restless and rapidly goes into collapse.

Nervous Symptoms.—Extreme irritability and fretfulness are found in the majority of childish patients. Headache and joint and muscular pains are frequent and sometimes intolerable. In many cases there are noticed an indifference and a hebetude which closely simulate a typhoid condition. Convulsions take place in a small percentage of children, and congestion of the brain with drowsiness may be noticed. In one case which came under my observation the child did not close its eyes for four nights. It was not unconscious, but indifferent, and wanted to be left alone. In a few cases meningitis will seem imminent, and the diagnosis will sometimes necessarily be held in abeyance. In some children afflicted with influenza there is developed an obstinacy which is truly remarkable; they sometimes resist the slightest touch, and refuse all examination on the part of the physician. This peculiarity is regarded by some observers as of diagnostic importance in differentiating from typhoid fever.

Temperature.—In addition to what I have already said, I have noticed that the fever may be very high and yet recovery take place. On the other hand, a temperature of 101° to 102.5° F. may persist for a period of two or three months. In these cases I have suspected and have repeatedly examined for evidence of tuberculosis, and have not found it, the patient finally making a good recovery after this long period of sickness. In general, we may make the statement that the temperature is more irregular in influenza than in any other disease.

Complications and Sequelæ.—These are numerous and varied, and attack nearly every function and organ of the body. Glandular enlargements are frequent. Inflammation of the parotid gland may take place. Abscess of the antrum and inflammation of the connective tissue of the neck have been noticed. Tuberculosis and tubercular meningitis may follow in a few cases. Conjunctivitis may remain, and catarrhal inflammation of the middle ear, resulting often in perforation and profuse discharge, will be noticed. At times this involvement of the middle ear, while always a serious complication, may even threaten the life of the patient. Diseases of the skin are sometimes noticed, such as erythema, herpes, and urticaria.

Among the more general diseases that have been observed are rheumatism, chorea, nephritis, and periostitis. Children having a tendency to rickets have been known to develop the disease after having had an attack of influenza. Among the complications which I have noticed, and which I have not seen

recorded, is purpura. Of this I have seen four cases, all in young people, and attended with extreme weakness and with evidence of more or less blood-change.

As is not unusual in adults, acute mania has been observed to follow the disease occasionally in children, but generally ends in complete recovery. Dr. Julius Althus, in an extensive article on mental affections after influenza, gives cases illustrating neurasthenia, hypochondriasis, melancholia, delirium from inanition, homicidal tendencies, and general paralysis. He believes that the psychoses observed after epidemic influenza are far greater than those after any other infectious disease.

Diagnosis.—From the rapidity with which it seizes the patient, influenza might be mistaken for sunstroke, an acute poisoning, or malignant malaria. It can be confounded with all diseases of the respiratory apparatus, with typhoid fever, and with meningitis.

From a simple catarrh, influenza will be distinguished by the fact that it is epidemic, and that there is greater prostration, which continues for a longer period of time, than in the first-named disease. The temperature is also higher, and there is a tendency to catarrhal difficulties—at first local, but rapidly spreading to other portions of the body. A mild catarrh, with severe neuralgia and with unusual pain in the limbs, should be diagnosticated as influenza if this disease be prevalent. The same may be said in regard to an irritable stomach, with diarrhœa and an unusual prostration. This in a time of epidemic should certainly be classed as influenza. From pneumonia and bronchitis, simple or capillary, we differentiate influenza by the absence of the usual physical signs, although at the commencement of the grippe in many cases there will be symptoms of pneumonia, and it seems as if localization had indeed taken place; but frequently in a few hours this becomes diffused, and a general bronchitis with the excruciating pain and prostration belonging to influenza is detected.

From typhoid fever influenza is differentiated by the fact that no rose-spots appear and no enlarged spleen is found, and the catarrhal condition, more particularly in the respiratory tract, predominates over all other symptoms. If diarrhœa exists in influenza, it will be noticed that a cough and a catarrhal state of the air-passages has preceded its development. The fever in influenza is irregular; in typhoid it is so regular and constant that it almost makes its own diagnosis. It is not usual to notice the apathetic facial expression that we have in typhoid. The face, however, is usually flushed in influenza—more frequently pale in the continued fever. There are no rose-spots in influenza, no tenderness and gurgling in the right inguinal region.

From meningitis influenza can usually be diagnosticated by careful observation of the eye and by the want of the rigidity of the muscles which we find in meningitis. The disease of the brain usually develops rapidly, and if death does not take place it disappears quickly. I must, however, say that the differentiation of meningitis from certain forms of la grippe is attended with great trouble, and a diagnosis must in some cases be withheld. When the fever persists after all other symptoms of influenza have subsided, and there is a cough with gradual emaciation, the closest care must be taken that a tubercular disease does not come in. Particular attention should be given to nutrition, and every means should be taken to diagnosticate the disease early.

Prognosis and Mortality.—In this connection an interesting topic might be discussed as to whether one attack of influenza protects from subsequent attacks. I do not think that this question at present can be fully answered, but the general statement can be made that many families particularly afflicted

in 1889 did not develop the disease in 1890 or 1891. There are those who are immune from the disease, and others in whom it has developed three consecutive years.

The mortality is different in different epidemics, and the character of the epidemic must be considered, as in all other infectious and contagious diseases. In some epidemics children are particularly liable to contract the disease, while in others adults seem to be selected. And again in a more general epidemic it has been noticed, as I can personally attest, that children often are not attacked until the disease has prevailed for some time. When the attack is moderately severe, I regard it a dangerous malady for a child, particularly if he has anæmia or any vicious constitutional tendencies. Death has taken place in twenty-four hours. It may come from almost every complication, but, in the main, exhaustion and bad nutrition bring about the fatal result. Death may come with such rapidity that in summer insolation is suggested, and at other times malignant malaria. In the fulminant variety with rapid death, the severe symptoms will be referable to the nervous system, while throughout the entire history of other cases the poison selects the respiratory or gastro-intestinal tract, and death comes as it does in those diseases when not complicated with influenza. But it must be remembered that there is always a tendency to collapse and a prostration out of proportion to other symptoms.

The length of time consumed in convalescence from this disease is wonderful. The pains and general weakness do not disappear for weeks; and I may add that many of the sequelæ remain for years, and not only produce suffering, but shorten the life of the individual.

Treatment.—I have no particular remedy or combination of remedies to suggest. I think, however, that care should be taken to prevent the contagious element from spreading and gaining a hold on the community, and, in view of the great mortality and the immense money loss which this disease causes, it appears to me that the time will come when it will be regarded as the duty of all municipal authorities to assume such control of the disease as science suggests.

Let the people understand that it is a contagious disease, and instruct them how to prevent its spreading by contact. All handkerchiefs and cloths used by the patient must be immersed in some antiseptic fluid, and all cuspidors and articles of furniture which come in contact with the germs of the disease should be carefully disinfected.

A generous diet must be insisted upon, some stimulation, and a conservation of all the strength of the patient observed from the outstart.

For the general pain which pervades the entire system, which sometimes is the first and most prominent symptom, nothing has given me such good results as phenacetin and salicylate of sodium. The catarrh of the respiratory tract which speedily prostrates young children should be early treated with stimulants, including the ammonia preparations and the ordinary expectorants. The gastro-intestinal catarrh must not be neglected, but should receive attention from the first. It is a clinical fact, which must have been observed by many, that in some of the neglected cases there is just as profound and general collapse from the copious diarrhœal discharges and vomiting, which we sometimes see in this form of the disease, as from those which take place in severe cases of cholera infantum. They should, then, have attention from the very first. For the extreme fatigue and depression not only alcoholic stimulants, but the effervescing waters with quinine, should be administered. If the stomach is particularly irritable, let the quinine be administered by inunction or by the rectum. Children take eagerly and with good results whipped egg-albumin

with sterilized water and a little stimulant and sugar. Champagne is excellent for the depression which is so evident among these little people. When there is great prostration following the involvement of any of the three systems we have mentioned, the carbonate of ammonium, camphor, and musk, fortified by the conjoint use of digitalis and nux vomica, are indicated.

When the patient begins to pass out from the more painful and acute manifestations of the disease, in addition to a generous diet a tonic composed of the compound syrup of hypophosphites, extract of malt, and pepsin cordial, equal parts, with a very small amount of elixir of bark, iron, and strychnine, acts efficiently.

ERYSIPELAS.

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Philadelphia.

Erysipelas is an acute, specific, contagious, inflammatory disease of skin and mucous membranes, accompanied by marked general symptoms, and characterized by peculiar local lesions at the seat of inoculation, by its tendency to spread, and by the presence in the affected area of a micrococcus that is capable of reproducing the disease in other individuals.

The word "erysipelas" is probably derived from *ἐρυθρός*, *red*, and *πέλλα*, *skin*. Numerous qualifying words have been used to signify the point of involvement, the course of the disease, the appearances presented by the local lesion, the age at which the disease occurs, etc. The terms "traumatic" and "idiopathic" have been used to distinguish cases wherein there is or is not an antecedent obvious wound of the skin at the seat of the local lesion. No qualifying words should be used as implying an essential difference in the process, as it is a disease *sui generis*, no matter under what circumstances it may occur.

History.—Erysipelas has been known from the time of Hippocrates, but the descriptions of the disease given by most writers prior to those of the last century show that many diverse diseases were included under this name. When humoral pathology occupied men's attention, this, in common with many other maladies, was supposed to be the outward expression of morbid humors in the body. At a later date it was looked upon as a simple dermatitis; still later, as a simple lymphangitis. The contagiousness of the disease was pointed out by Lorry in 1777. A microbic origin was first suspected by Martin in 1865. The question of priority in demonstrating this origin is still a matter of dispute. Between 1868 and 1870, Nepveu and Hueter described the occurrence of microscopic organisms in connection with the disease. It need only be stated here that the description given by Nepveu corresponds more closely than does that of Hueter to the micro-organism now established as the cause of the disease. Since 1870 many observers have studied the disease from a bacteriological aspect, but it is especially to Fehleisen that we owe our present knowledge of the life-history and etiological rôle of the micrococcus described by him in 1882.

Etiology.—The disease is limited in its occurrence to no part of the civilized world, but its favorite habitat is the temperate zone. It but rarely occurs in the tropics, being less rare in regions far removed from the equator. In Greenland, for example, occasional widespread epidemics have occurred.

The predisposing effect of season can be readily seen by the accompanying chart (Fig. 1). It will there be found that by far the greater number of fatal cases in Philadelphia occur during the latter part of the first and the early portion of the second quarter of the year; that is, during the early spring months. Allen analyzed 566 cases applying for treatment, and obtained practically the same result.

It appears to be most prevalent among the poorer classes. This may be due to several causes—the greater liability to injury, frequency of chronic

FIG. 1.

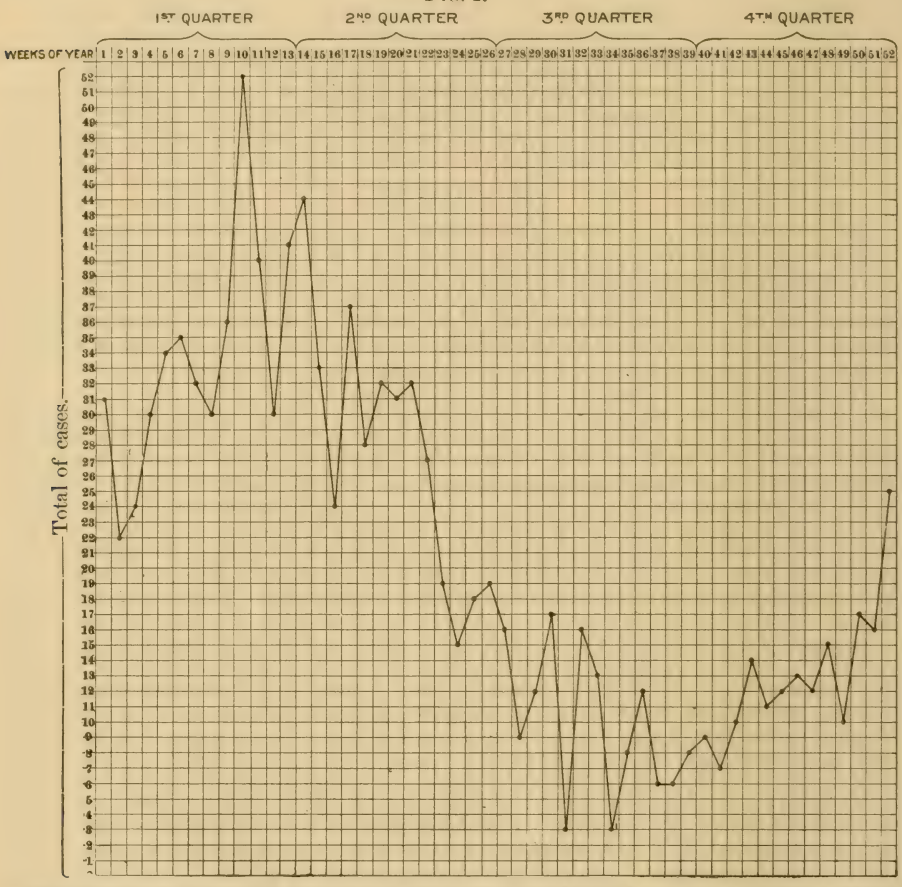


Chart showing the Number of Fatal cases of Erysipelas in Philadelphia occurring in different seasons from 1874 to 1891.

superficial inflammatory troubles, lack of cleanliness, want of ordinary sanitary precautions, and neglect of proper isolation amongst those attacked.

The question of age as a predisposing factor is difficult to determine, as only fatal cases appear in the reports of boards of health. Of 12,556 fatal cases of the disease in England between the years 1862 and 1868, there occurred under one year of age 31 per cent.; under five years, 5.9 per cent.; under fifteen years, 2.9 per cent.; under twenty-five years, 4.2 per cent.; under forty-five years, 12.4 per cent.; under sixty-five years, 20.9 per cent.; above eighty-five years, 1.4 per cent. In Philadelphia, during the period between 1874 and 1891, there occurred 1253 deaths from erysipelas. Of these, 380 were in children under one year of age, 35 between one and two, 23 between two and five, 25 between five and ten, 6 between ten and fifteen, the remaining 784 cases occurring in those past the latter age. All that can be said, therefore, is that no age is exempt. The large number of fatal cases occurring in the first year of life may be due to the almost uniform fatality of the disease during the early part of that period, and cannot be taken as an index of the actual number of cases occurring in infants.

What part filth and defective drainage may play in its production has not been definitely settled. In the older hospitals of Europe frequent epidemics have occurred; but it is not alone in these that erysipelas appears, new and apparently sanitary institutions being also the scene of its occurrence. A well-known and oft-quoted instance of the effect of polluted air is that which occurred in the Middlesex Hospital, where a defective drain was on two occasions the apparent cause of an outbreak of the disease, starting in the bed nearest to its position in the wall. It is said to be frequent in the immediate neighborhood of badly-kept stables.

The most important etiological factor is contagion. The contagious principle has but a limited area of influence, as is shown by some of the histories of local epidemics within hospital wards, wherein patients upon one side of a ward have been affected *seriatim* on both the right and left of the individual first attacked. Those in attendance upon a case are apt to contract the disease. One attack seems rather to predispose to, than to protect against, a recurrence, due probably to the fact that some breach of the surface produced by a chronic affection admits the poison.

The contagious principle is the *streptococcus erysipelatis*. Although previous investigators had discovered micrococci in the local lesion, the most careful and conclusive work upon the subject was performed by Fehleisen, hence the micro-organism is frequently spoken of as the streptococcus of Fehleisen. By him it was found in the lymphatic vessels and spaces of the skin and subcutaneous cellular tissue, and in the superficial layers of the corium. It occurs as a single cell or in the form of diplococci or chains of various length. The individual cell measures about 0.3μ in diameter. It is readily cultivated upon gelatin and blood-serum, where the colonies form as dull-white, round points, closely marginated or fusing at points of contact. It grows well at the temperature of the human body, is facultatively aërobic, and develops well *in vacuo*. Not only has the inoculation of pure cultures been successfully practised upon animals, but the disease has been inoculated upon human beings as a therapeutic measure.

In order that the parasite may gain access to the lymph-spaces, it is essential that some breach of the surface should exist. This means of entry may be supplied by some wound accidentally received or purposely inflicted, by the unhealed navel of the new-born, scarifications made for purposes of vaccination, the local lesion of vaccinia, the ulcers of varicella, solutions of continuity produced by eczema, intertrigo, ecthyma, or pemphigus, or by ulcers resulting from chronic inflammation of the mucous membranes of the mouth or upper air-passages. It is owing to the frequency of lesions at the points of union of skin and mucous membrane that the local manifestations frequently begin at those situations.

Pathological Anatomy.—After death the body-heat is maintained for a long time, and, according to Eulenburg, there is a post-mortem rise of temperature to a point .9° C. (1.5° F.) above that observed before death.

At the seat of the local lesion the vivid color gives place to a mere yellowish discoloration, and much of the swelling observed during life disappears. When the skin is incised there exudes a varying quantity of more or less discolored serum. The skin and subcutaneous tissue are somewhat thickened and cannot be readily separated. Microscopical examination of the affected skin shows that beyond the peripheral margin there are numbers of micrococci in the lymphatic vessels. As sections are made from without inward, the greatest histological changes are seen at the visible margin of the patch, where there are much serous infiltration separating the cells, and infiltration by round

and wandering cells, many micrococci being contained in the latter. From this point the alterations progressively diminish as the part earliest attacked is reached, until complete *restitutio ad integrum* is found to have occurred. The hair-shafts are unaltered, but there is serous and cellular infiltration of the root-sheath, and micrococci may be found in the space between the latter and the root. In lately-developed vesicles upon the surface no micro-organisms are to be found, but in those of longer existence various forms abound. In phlegmonous erysipelas there is an admixture of the staphylococcus pyogenes with the streptococcus erysipelatis.

The mucous membranes that are affected show the same appearance as does the skin, save for the normal structural differences in the tissue. Attacking the larynx, the disease produces marked swelling in the parts around the glottis. Œdema of the rima glottidis may be present. The trachea and bronchi may be of a brillant red color, with paler areas corresponding to the cartilaginous rings. Three forms of pulmonary lesion may be found: (1) an accidental croupous pneumonia, with the ordinary appearances of that lesion; (2) intense congestion, either general or limited to diseased branches of the bronchial tree, with scattered areas of red or gray hepatization within the congested area; (3) an acute infective interstitial pneumonia from bacterial embolism, with subsequent dissemination of micrococci in the interlobular connective tissue. In cases where the disease has spread from the air-passages the alveoli contain large numbers of leucocytes and many micrococci, instead of the fibrin and epithelial cells seen in croupous and catarrhal pneumonia.

Inflammation of the pleura may be found from extension of the disease through the chest-wall or as secondary to subpleural pulmonary lesions. The pleural cavity may contain serous or purulent exudate. The streptococcus has been found in pleural exudate. Suppurative anterior mediastinitis has been observed. Pericarditis is rarely seen, but endocarditis, affecting chiefly the free borders or the whole of a leaflet of the valves of the left side, is occasionally present. Granular degeneration of the myocardium also occurs, due doubtless to the elevation of temperature. The endothelium of the blood-vessels has been found to be swollen, granular, and with indistinct nuclei. Tutschek reports a case of thrombosis of the abdominal aorta. The streptococcus has been found in the blood of the skin, subcutaneous adipose tissue, and in the capillaries of the lungs, liver, spleen, and kidneys.

The stomach may exhibit marked engorgement of its vessels, the intestinal tract patchy redness. Multiple minute duodenal ulcers have been seen. In the large intestine the typical erysipelatous local lesions may be found in cases where the disease has spread from the perineum through the anus to the rectal mucous membrane.

The liver may be large and congested in rapidly fatal cases; in those of longer duration it is more often pale, soft, and the seat of fatty degeneration. Many observers have found the streptococcus within the organ.

By most authors the spleen is said to be increased in volume, as would be expected from the frequency of its enlargement during life in non-fatal cases; but Denucé found it small, soft, and hyperæmic.

Peritonitis is comparatively rarely found, most instances of its occurrence being in the new-born, where the abdominal wall has been the seat of the primary process.

In spite of the prominence of cerebral symptoms during life, there are but seldom found any marked structural alterations within the cranium. The membranes may be anæmic or their vessels intensely engorged with blood. Actual meningitis is rarely seen. An instance is reported by Osler of menin-

gitis and thrombosis of the lateral sinus in a fatal case of facial erysipelas wherein the process could be traced along the trunk of the fifth cranial nerve.

From the frequent presence of albuminuria it is to be expected that in fatal cases the kidneys would show structural alterations. In five cases examined by Denucé these organs showed nephritis in degrees varying with the duration of the case. Langer has reported a fatal case of erysipelas of the scalp occurring in a seven-weeks-old boy, and complicated by hæmoglobinuria, wherein the kidneys showed infarcts and miliary abscesses. In the articular inflammatory exudate that sometimes occurs Schüller found the streptococcus.

Symptoms.—In spite of the fact that in six cases purposely inoculated by Fehleisen the initial chill occurred in from fifteen to ninety-one hours, the incubation for cases accidentally inoculated may be reckoned as requiring a period of from three to seven days.

The onset may be sudden, the first symptom being a chill with rigor. In other cases feelings of languor and vague discomfort in the part that later becomes the seat of the local lesion may precede the occurrence of chill. In young children the occurrence of an initial convulsion is not infrequent. The attack may begin with severe inflammation of the upper air-passages or throat, the skin lesion not appearing for twenty-four or thirty-six hours after the first signs of illness. The temperature rises rapidly to 102°, 103°, or even 105° F. The affected area soon becomes the seat of burning, smarting pain. The local appearances at this time may merely amount to slight redness and glossiness. In a short time there is slight elevation of this reddened area above the surrounding healthy surface, the color deepens in shade, and there are pitting and pain upon pressure. The color is readily dispelled by pressure, but quickly returns upon the withdrawal of the finger. The pain becomes more intense, and there is a sensation of stinging and stretching in the affected part. The tongue is coated, there is anorexia, thirst may be marked, varying degrees of cephalalgia are present, while nausea is a frequent source of complaint. Vomiting is not frequent in cases of ordinary severity. At this stage the pulse is usually full, bounding, and rapid. Upon the second day the temperature-chart shows a slight morning remission. The redness and swelling extend from the original site to cover a larger area; the eyes may be invisible from swelling of the lids, the ears swollen and distorted, and the lips thickened. Cephalalgia becomes intense, especially if the scalp be invaded; insomnia and delirium frequently appear. Albuminuria, with a copious deposit of amorphous urates, will usually be found after the first few days. On the second or third day the local appearances of the part first attacked reach their highest degree of development. Thereafter the redness and swelling of that part subside. Meanwhile the local process may have steadily advanced from the point of its original appearance until large areas of skin are involved. When extension ceases the temperature rapidly falls, the pulse becomes less bounding and its frequency diminishes, pain lessens, the associated symptoms rapidly subside, and the patient enters upon convalescence. During convalescence the affected skin has a faint yellowish discoloration and is the seat of desquamation, the epidermis separating in branny scales or in large flakes, and in cases where the scalp has been invaded the hair falls. Albuminuria may persist in lessening degree for several days after the cessation of other symptoms.

Important variations from this ordinary type occur and require separate consideration.

Erysipelas of the new-born begins either at the navel or at a point nearer to the symphysis pubis. Thence extension rapidly occurs until the skin of the whole abdomen, that of the extremities, or even larger portions of surface, may

be involved. The infant exhibits extreme restlessness and has high fever, may vomit frequently, and soon passes into an asthenic condition that speedily ends in death. In other cases the process extends along the still patulous umbilical vein, reaches the liver, and may lead to fatal peritonitis. After the early days of infancy are passed the disease shows the same characters in children as in adults.

Where the mouth, tonsils, pharynx, or nares are primarily attacked, the local appearances are those of an intense inflammation of the part affected, but swelling is more marked than usually occurs with ordinary inflammation, and the tendency to spread to adjacent structures and the skin is a peculiarity of great diagnostic importance. From the nares it may extend to the lachrymal duct and attack the skin near the internal canthus. From the upper air-passages the process may extend to the bronchi or to the lungs, producing the symptoms and physical signs of an intense bronchitis or pneumonia. In the primarily laryngeal form hoarseness begins early, and may be rapidly followed by symptoms of suffocation due to the intense swelling of the mucous membrane.

The eruption exhibits certain peculiarities worthy of further study. Extension usually takes place most rapidly in one direction, but not in an even line, as flame-like tongues of redness frequently jut out in advance. The area of redness and swelling is bounded by an abrupt fall to the level of the healthy surface. Extension from the face usually occurs upward, reaching the hairy scalp or even passing backward to the nape of the neck or to the trunk. From the trunk it may spread to the extremities or head, and *vice versâ*. One striking peculiarity of the eruption is its liability to terminate at natural boundaries—the borders of the hairy scalp, the various folds of the face, the groin. Where the underlying bone is close to the surface the eruption is frequently absent; thus the chin may be spared, while the rest of the face is much swollen. Conversely, where the skin is but loosely attached to underlying structures—as in the scrotum, labia majora, and eyelids—swelling is very marked, and gangrene may occur from interference with the circulation. Besides redness and swelling, other appearances are usually present in the affected area of skin. Vesicles, or even bullæ with clear or muddy contents, are apt to form. Pustules are rarely seen, but in some regions with resisting skin a verrucose appearance may be presented from cellular infiltration. Minute points or quite extensive areas of gangrene may occur. The bursting of the vesicles and bullæ causes the formation of yellowish or brownish crusts. After the active process in a part has subsided the surface is covered with bran-like scales, large flakes of detached epithelium, and crusts of varied hue. The hair may fall very rapidly, leaving the scalp bare, smooth, and shining.

The temperature-curve follows quite accurately the extension and subsidence of the local process. After the latter has entirely subsided there may remain an elevated temperature, owing to the presence of irritation or actual inflammation of various organs. Cavafy has reported five cases, and I have seen one, of erysipelas of the face without pyrexia.

Not only may the urine contain albumin and an excess of urates, but hyaline and granular tube-casts may also be present. These disappear after the cessation of the disease in the majority of cases. Their presence may be the evidence of the rekindling of a pre-existing disease of the kidneys, in which case they will usually persist or even increase as time passes.

Complications and Sequelæ.—The lung is perhaps the most frequent seat of complication in erysipelas. Pneumonia of the ordinary type is of not

infrequent occurrence, or the specific process may attack the lung-structure. Pleurisy (with or without effusion), empyema, peri- and endo-carditis at times occur. Pleurisy occurred twice in eight cases purposely inoculated by Fehleisen. Previously-existing nephritis is apt to be awakened into activity, and uræmia may be the immediate cause of death. Hæmoglobinuria may be a complication, as in the case reported by Joseph Langer. In facial erysipelas suppurative inflammation of the orbital connective tissue is much to be dreaded, and is frequently fatal from extension to the cerebral meninges through the optic foramen or sphenoidal fissure. Amblyopia or complete amaurosis may result from pressure upon the optic nerve or vessels of the eyeball. Obstinate vomiting is at times a serious complication. Diarrhœa frequently occurs, and the stools may contain blood. After the active signs of disease have disappeared superficial abscesses frequently form.

Erysipelas is, according to Gowers, rarely followed by paralysis. Optic neuritis, optic atrophy, or thrombosis of the retinal vessels may follow compression of the optic nerve and ophthalmic blood-vessels in cases of orbital cellulitis. Amblyopia may be due to retinal hæmorrhages, detachment of the retina, or opacities in the vitreous. In 9209 cases of adventitious deafness analyzed by W. B. Post, erysipelas was the alleged cause in 36.

Diagnosis.—In ordinary cases the diagnosis is readily made. The sudden onset of marked constitutional symptoms coincidently with or rapidly followed by the red, elevated, painful lesion of the skin, the peculiar qualities of the latter, and, in particular, the tendency to spread, sufficiently stamp the disease. When the mucous membranes are first attacked it may be impossible to make a positive diagnosis until the skin becomes affected; but here also the rapid and continuous spread of the disease along the mucous membrane, together with the intense swelling and brilliant redness of the part, should suggest the erysipelatous nature of the inflammation.

Where the poison has entered through the lesions produced by eczema of the hairy scalp, such as is so frequently seen in the neglected children of the poor, the cause of the constitutional symptoms may be only discovered upon the extension of the local process to the forehead, neck, or ears.

From simple erythema the diagnosis is made by the tense swelling, the sharply-defined border, the more marked ambulatory character of the lesion, the fever, and other marked systemic symptoms of erysipelas.

From angeio-neurotic œdema this affection differs in all points save the fact of the presence of swelling. From ordinary urticaria it may be distinguished by the rapid appearance and reappearance of "hives," and by the occurrence of the eruption simultaneously in different portions of the body.

The local appearances of acne rosacea sometimes closely resemble those of erysipelas, but the clinical history, the rapidity of extension, and the constitutional symptoms of the latter disease clearly differentiate the two affections.

From malignant œdema the diagnosis must be made by the method of spreading and the local appearances peculiar to the two diseases. Malignant œdema more frequently occurs at points where the skin is particularly thin than does erysipelas.

Prognosis.—In uncomplicated cases the usual result is in complete and rapid cure. In the new-born (that is to say, in those under the age of fifteen days) the disease is practically always fatal, owing in part to the lack of resisting power in those so young, in part to the ease with which extension occurs, and in great part to the liability to the occurrence of phlebitis of the umbilical vein and of peritonitis. In older children complete cure usually results.

Among especially unfavorable occurrences may be mentioned suppuration in the orbital space, gangrene, signs of inflammation of the lung, pericardium, or endocardium. When optic neuritis, optic atrophy, or thrombosis of the retinal arteries occurs, the prognosis as to return of vision is unfavorable. Permanent baldness but seldom results, in spite of the complete alopecia that often is present immediately after the attack.

Treatment.—In this disease the same rules in regard to isolation should be followed as in other contagious diseases, save only in the degree to which it should be practised. Occurring in the medical wards of a hospital, it may not attack other individuals, providing that the beds are in not too close apposition. The contagiousness of erysipelas is not sufficient to warrant the exclusion of cases from medical wards that are properly separated from the surgical and obstetrical departments. It is sufficient that the patient be so placed that he may be surrounded by those having no breach of cutaneous or mucous surfaces. In surgical and obstetrical wards cases of erysipelas should be excluded, and the occurrence of an attack should be the signal for immediate isolation.

No safer means for the prevention of the disease exists than the use of thoroughly antiseptic methods as regards the wards, the operating-room and its appurtenances, the persons of operators and assistants, and the dressings employed. Where attacks recur in an individual any existing lesion that may give entrance to the poison should receive careful and prompt treatment.

In the case of a self-limited disease, and one that rapidly subsides without warning, deductions as to the efficacy of any particular line of treatment must be most carefully drawn. The methods employed in erysipelas are too numerous to be here enumerated; suffice it to mention a few of those that have stood the test of prolonged use by various observers.

A mercurial purgative is advantageous in the early stages and before the institution of any line of treatment. But two drugs deserve mention as having any effect upon the course of the disease—tincture of the chloride of iron and jaborandi. After prolonged trial the first of these seems to have some influence in modifying the severity and shortening the course of the attack. It is best given in large doses, 5 to 15 drops, every three or four hours according to the age of the child. Under its use there is usually found a rapid cessation of extension of the local process and subsidence of the general symptoms. Jaborandi, or its alkaloid pilocarpine, was first recommended by DaCosta, and has had numerous advocates since the announcement of its value in erysipelas. In children, however, it must be given with caution and in doses carefully graduated to the age of the child, the object being to give by hypodermic injection an initial dose of pilocarpine sufficient to produce a pronounced sweat, and thereafter to give every four hours doses of the fluid extract of jaborandi sufficient to maintain a gentle diaphoresis. In adults the method is decidedly beneficial, but in children its use requires caution and careful watching by an intelligent attendant.

The almost purely mechanical rules that govern the extension and limitation of the local process have led to various attempts to substitute artificial boundaries for those of nature. For this end pressure applied in advance of the lesion has been extensively employed by means of tight bandages of elastic material, by the application of strips of adhesive plaster, and by collodion. In many situations no form of pressure is practicable save that by collodion; but the depth to which the constriction by collodion reaches is too slight to offer any obstacle to the spread of the process. Where the other methods are available the application of constricting bandages sufficiently tight to accomplish the object in view is apt to be too painful for their long continuance. As,

however, this does not preclude the employment of other methods of treatment, it should be tried wherever practicable.

Attempts have been made to stay the spread of this specific inflammation by the production of simple inflammatory exudation. For this purpose incisions were made or the solid stick of nitrate of silver was applied to the skin beyond the affected area. Scarification of the healthy skin beyond the edge of the patch has been, and is still, used by some for the same purpose. Hueter first introduced the injection of 2 per cent. carbolic-acid solution under the skin threatened with attack. In some cases it seems to have limited the process, but the method is not always successful. It is, however, rational.

As applications to the diseased area many materials have been recommended, such as flour, lycopodium, or other bland powders, white paint, lead-water and laudanum, cold water, vinegar and water, turpentine, and tar. These are now but seldom used, except white paint and lead-water and laudanum. The exclusion of air of itself seems to relieve much of the discomfort and pain. On this account any emollient application is agreeable. To the fatty base various substances may be added. One of the most agreeable is the hydrochlorate of cocaine in the proportion of 16 grains to the ounce. This usually relieves pain very markedly. Resorcin in the strength of a drachm to the ounce may be used. Koch recommends the application, by means of a bristle-brush, of a mixture of creolin 1 part, iodoform 4 parts, and lanolin 10 parts. Spraying of the affected surface with a solution of corrosive sublimate has been recommended, but greater relief of discomfort, with more likelihood of reaching the deeper parts, can be obtained by the use of constant applications of emollient preparations.

The diet should be nourishing and easily digestible. Milk should constitute the basis during the acute stage of the disease, but eggs, broths, and soft milk foods may be given, except when fever is so great as to interfere with the process of digestion. In all cases occurring among the debilitated, and particularly in very young children, stimulants will be almost invariably required. The amount to be given depends upon the age and condition of the patient.

For extreme elevation of temperature the application of cold externally by means of sponging with cool or cold water, the wet pack, or the cool bath should be employed. Where the hyperpyrexia resists these measures, or where they cannot be properly applied, antipyrine, acetanilid, or, better still, phenacetin, may be cautiously tried. The drugs mentioned should only be employed with extreme care and in minimum effectual doses.

For delirium bromide of potassium or sodium may be given, either by mouth or rectum. Cold applications to the head may be sufficient to moderate the symptom. Opiates are to be used only as a last resource and with great circumspection, not only because of the danger attending their use in childhood, but also because of the liability to insufficiency or actual inflammation of the kidneys in this disease.

Impending suffocation from swelling of the rima glottidis may require tracheotomy. Any purulent collections that may form should be promptly released by the knife.

After the subsidence of the disease tonics with hæmatinics will be required. The alopecia that occurs in some cases usually requires no special treatment, but friction of the scalp and the use of cantharidal preparations will hasten the growth of the hair.

Therapeutic Use.—A few words must be added regarding the use of erysipelas as a therapeutic measure. For many years back there are to be found reports of cases wherein an intercurrent attack of erysipelas was followed by

an amelioration or complete subsidence of the primary affection. The frequency of this phenomenon led to the intentional inoculation of erysipelas for the cure of various affections that were resistant to other measures of treatment, were inaccessible to the surgeon's knife, or whose existence was incompatible with that of erysipelas. Among the affections alleged to have been cured by such an attack of erysipelas or by the intentional inoculation of the streptococcus of Fehleisen may be mentioned various lymphosarcomata, epitheliomata, lupus, and various other chronic superficial ulcerations, keloid, neuralgia, various psychoses, acute polyarthritis, and pulmonary tuberculosis. The antagonism between erysipelas and diphtheria has led to the inoculation of the former upon the latter disease.

While many favorable reports as to the action of erysipelas in the reduction or complete removal of sarcomatous and carcinomatous tumors are to be found, there are others where either no result has been obtained or where recurrence of the growth has taken place, or even death has been brought about by the erysipelatous attack. The cases of neuroses and neuralgia that are found to have been relieved by an attack of the disease can be duplicated by those wherein cure has resulted after many different mental or physical impressions.

In regard to the superficial skin lesions, the favorable action of erysipelas may be explained by the local influence of the inflammation produced as part of the latter. As to the favorable result in a case of pulmonary tuberculosis reported by Chelmonsky, it can only be said that further evidence must be brought forward before any definite curative influence of erysipelas upon this pulmonary lesion can be acknowledged.

Attractive as is the theory of the antagonistic action of the bacterial products in one disease upon its own micro-organisms or upon those of another malady, it seems as yet unjustifiable to purposely add to the existing affection a disease which, while usually ending in recovery, not only may of itself prove fatal, but which is often observed as the final and fatal complication of many long-standing cases of incurable disease.

CHOLERA ASIATICA.

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This disease would be most properly designated as *cholera infectiosa epidemica*, for in this term a definite idea of its chief characteristic and of its most marked tendency would be included.

Cholera Asiatica is an exceedingly dangerous specific human disorder, primarily of the digestive tract, occasioned directly by the ingestion, entrance into the small intestine, and exuberant multiplication there of special minute vegetable parasites, the spirilla choleræ Asiaticæ, the so-called "comma bacilli" of Koch. The special poison elaborated by the growth of the parasites in the intestines attacks the epithelial lining of the latter, ultimately reaches the circulation and the nerve-centres, and causes the complex phenomena which characterize the disease.

The intestinal contents, the vomit, and the stools of the attacked contain these specific parasites in enormous numbers, and they are infectious so long as the latter retain their vitality and power of reproduction; so long as their infectious quality persists they are capable, under favorable circumstances, of causing an attack of the same disorder in another exposed, susceptible person, and of giving rise to a local or widespread epidemic of the same disease. For the latter reason does the danger to the public always outweigh in magnitude even that to the individual attacked.

Cholera Asiatica is *endemic* in the lower two-thirds of the presidency of Bengal, roughly corresponding to the delta of the Ganges and the Brahmapootra; it becomes *epidemic* in other parts of Hindostan and of the world only periodically, after more or less irregular intervals of entire absence. During the intervals of epidemics, except as scattered cases shortly preceding or following such visitations, and as an essential part of the latter, it does not exist outside the endemic area: it has no more affiliation with or relation to our somewhat common so-called summer cholera—otherwise termed *cholera nostras*, cholera morbus—than it has with some acute attacks due to arsenical poisoning, to ptomaïne-poisoning from ingestion of decomposed food, or to acute pernicious malaria, or to still other very different disorders, all of which, nevertheless, not infrequently present very similar symptoms and terminations.

Etiology.—Although abounding filth of the surroundings—that is, of the district or the locality, of the domicile, of the home-life, and of personal habits—favors infection and the subsequent development of an individual attack, and the initiation, continuance, and spread of an epidemic of cholera Asiatica, neither a personal seizure nor an epidemic outside that endemic area which is the natural home of this disease can occur (not even when the person or population wallow in every sort of reeking abomination), unless the special infection be first introduced. In other words, no amount of filth is capable of producing a *spontaneous generation* of the specific infection which is the active

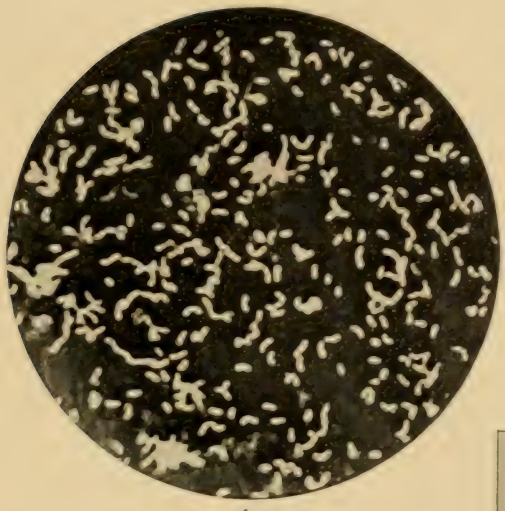
cause of this disease; nor, without the activity of this specific cause, is any other agency or influence capable of producing the disease.

The active specific cause of cholera Asiatica is the presence and multiplication in the intestinal canal of the subject of numbers of very minute vegetable parasites, certain well-defined species of bacteria known as the spirillum choleræ Asiaticæ discovered by Koch in 1883, and because of their usual resemblance under the microscope to the written *comma*, and of the name of its discoverer, commonly called the "comma bacilli of Koch."

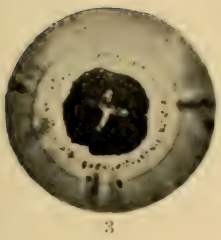
The term "bacillus" as applied to this vegetable micro-organism is, however, a misnomer, for the species is now regarded by nearly all competent authorities as a member of the group of spirilla. As commonly encountered in the intestinal contents or vomit of a victim of the disease, and in artificial culture media when growth is recent and rapid, if a fresh preparation be placed under a microscope of very high power and excellent definition, this micro-organism is usually so actively mobile as to defy distinct vision. If the fresh preparation has been made from a recent pure culture, and there be plenty of fluid under the thin cover-glass, the movements of the comma bacilli remind one of the rapid, darting, zig-zag movements of the individuals of a swarm of small flies, and of the impossibility of distinct vision of any one of the swarm. If, however, a smear-preparation from such a culture be made, and after drying and flaming in the usual manner, this be properly stained, mounted, and examined, it will be seen that each form is more or less curved—a few almost imperceptibly so; a few others nearly as much as a semi-circle; the greater number having a curvature representing an eighth or a quarter of a circle. The length may vary from one-seventh to one-fourth the average diameter of the red blood-corpuscle of man, the width being about a fourth its length. Examined critically it can often be seen that, instead of forming a segment of a circular ring, the individual form is in reality a portion of a spiral. The ends are blunt but rounded, sometimes slightly tapering, then presenting an outline similar to the fennel-seed. When proper methods of staining are used each end of the "comma bacillus" is found to be furnished with one or more flagella, which act as motive organs. Cultivated in bouillon by the hanging-drop method, besides the above-described forms there are usually seen a variable number of more or less long and complete spirilla. Old cultures in bouillon, in gelatin, in agar, and in other media nearly always contain the comma and spiral forms, and intermingled with these are frequently other shapes, which many authorities regard as involution forms. Chief among the latter are spherules of a diameter from that of a cross-section of the comma to that of a red blood-corpuscle of man, and even greater. It is pretty certain that neither the comma nor the spirillum forms contain spores; vacuoles have been mistaken for them. In the vomit and intestinal contents of the attacked the comma forms are always present for a number of days, and short and incomplete spirils may sometimes be demonstrated in smear-preparations.

The comma bacillus of Koch multiplies commonly by two modes, each of which, however, constitutes essentially a process of fission: *a*, the comma doubles its length, and then divides into two; *b*, before dividing the comma continues its elongation into a longer or shorter spiril filament, which ultimately becomes segmented in order that finally the segments may separate to form new and separate commas. Of these two processes of multiplication, the former is by far the more rapid. Elongation and division of the one comma into two have been actually observed under the microscope to take place in twenty minutes. With such a rate of multiplication demonstrated, one can easily form some adequate conception of the otherwise inconceivable rapidity of

PLATE IX.



1



3



4

2



FIG. 1. Photo-micrograph: Smear preparation from pure culture of comma bacillus of Koch. × 1200

FIG. 2. Photo-micrograph: Smear preparation from (old) pure culture in gelatin of comma bacillus of Koch, showing oögonia of Ferrán or involution forms of other authors. × 1200.

FIG. 3. Photo-micrograph: Gelatin-plate colony of comma bacillus of Koch. × 50.

FIG. 4. Photograph: Gelatin tube-culture of comma bacillus of Koch, 72 hours old, surface inclined. Natural size.

propagation and enormous power of dissemination in river-water of the specific infectious principle of Asiatic cholera contained in the discharges from the bowels of a few cases, numerous examples of which the history of this disease affords; one of the most striking being the most recent—namely, that of the river Elbe in 1892. Of other possible modes of multiplication, only two may be merely mentioned here: that by intervention of so-called arthrospores of Hüppe, who claims that these reproductive bodies approach the tenacity of life and the power of resistance of genuine spores; and that of so-called "öogonia" of Ferrán—both modes being a form of multiplication by budding.

The multiplication of the comma bacillus of Koch in artificial culture media has been found to vary greatly under different constitution of media and varying conditions of temperature, etc. During the development and continued growth of these organisms in artificial culture media, chemical combinations are split up and various new chemical products formed, as the necessary accompaniment of the nutrition, life, or death of the microbes; and these resultant new chemical products vary in quantity or composition, or both, with the varied chemical and physical complexion of the culture media, the external conditions of temperature, moisture, free oxygen, light, etc. Thus it seems to be now pretty clearly established that in artificial culture, among many other characteristics, the cholera microbe will not develop at a temperature below 57$\frac{1}{5}$° F. or above 107$\frac{3}{5}$° F.; that freezing, unless it be prolonged, does not kill this microbe, but places it in a state of hibernation, as it were, ready to resume again all its vital and pathogenic functions with the return of sufficient heat; then, on the contrary, when a temperature of 107$\frac{3}{5}$° F. is exceeded the vital functions of the microbe are more and more inhibited permanently, if the temperature be continued, until a point is reached, at about 140° F., where the life of the microbe is destroyed absolutely in a very few minutes; that multiplication is more rapid in fluid media of suitable constitution; that the culture fluid, as a rule, possesses more virulence when the inoculated microbes are very recently obtained from an active case of cholera than when a long time has elapsed; that the presence of peptone in the culture medium seems to materially increase the development of the virulent power of the microbe, especially when free oxygen and light are excluded; that there is scarcely any fluid or solid moist nutrient material of animal or vegetable composition, of a neutral or slightly alkaline reaction and not containing a substance possessing antiseptic properties, upon or in which it will not grow; and there are at the same time many fruits and vegetables upon the pulp or surface of which the microbes of cholera will not only live for hours and days, but will multiply there even when the object gives a slightly acid reaction. This microbe will live and multiply enormously for a time in pure water, in foul water, even in sewerage, and in sea-water; it will live for a considerable time and multiply enormously in milk, whether fresh or previously sterilized; it is capable of living and multiplying for a time in various common beverages and on various common articles of food. It will retain its vitality, sometimes multiply exuberantly, on various textile fabrics of vegetable or animal nature for days, and in some cases weeks and even months, if they be not thoroughly desiccated or exposed to the sun's rays, and contain no antiseptic susbtance; if such fabrics be kept decidedly damp or wet, the germ is capable of enormous multiplication, and of retaining its infectious and reproductive power to a virulent degree for indefinite periods, lasting for weeks or months, provided the sunlight does not fall upon it. If, however, these fabrics are thoroughly dry before the microbe is placed upon them, and remain or quickly become thoroughly dry afterward, it soon dies—more quickly still if exposed to the sunshine or bright reflected light. Whilst the propagative power of the

cholera microbe outside the human body, under favorable circumstances, is so enormous as to be almost incredible, fortunately for man it is, of all the dangerous pathogenic microbes known, the most susceptible to restraining or destructive influences. Whilst it is too often true that an individual, a community, a city, a whole nation, or even a continent, presenting favorable conditions for the free propagation of the infection, oftentimes suffers consequences which in their swiftness, gravity, and manifold relations may be appalling, yet there is no infectious epidemic disease which can so certainly and so easily be warded off or arrested as can Asiatic cholera.

Mention has already been made of the ingestion, entrance into the small intestine, and exuberant multiplication there of the "comma bacillus of Koch" as necessary conditions precedent to an attack of Asiatic cholera. Even with these it is probable that there must be one more condition before a serious attack follows—namely, susceptibility to the disease on the part of the individual. Since desiccation is one of the sure and rapid means of killing the microbe of cholera, and since the comma bacillus does not exist in the lungs or intestinal organs, in the blood, lymph, or muscular tissue, or in the nervous system of a person suffering an attack of cholera, it is obvious, *a priori*, that the active infection of this disease is neither inhaled nor does it enter through the cutaneous surfaces. But in this matter we are not obliged to rely upon inductive reasoning, for there is not a single example known of either mode of infection in the clinical history of cholera or in laboratory experience with this disease. The cholera microbe must be *swallowed* and pass from the stomach into the small intestine alive and endowed with vigorous powers of propagation and pathogenesis, before cholera can be naturally produced in man.

There are various means and modes by which the infection of cholera may be introduced into the œsophagus of man. It may be conveyed by various fluids imbibed, such as water, milk, beer, weak tea, etc.; by various articles of food, such as raw vegetables, bread, butter, fruits, meats, etc.; by contact of the mouth with hands in some way soiled through careless handling of objects contaminated with numbers of the microbe, such as the clothing worn by the sick, the bed-linen used by them, the vessels containing the vomit or stools, etc.; by water used for lavatory purposes or the washing of dishes or other food-receptacles; by water used for washing the mouth and teeth, etc. The corollary of all this is that Asiatic cholera is not acquired by inhalation or mere contact with persons suffering from the disease, or with things contaminated with the infectious principle. Moreover, there seems to be a natural insusceptibility on the part of many to an attack of cholera, although they be undoubtedly exposed to the infection. Numerous examples of this personal immunity are furnished by every great epidemic, especially when the outbreak has been caused by contamination of the common supply of drinking-water. Furthermore, there is incontrovertible evidence to prove that there is an acquired immunity of variable duration following a natural attack of Asiatic cholera, whether the latter have been grave or mild. Indeed, it is pretty certain that a natural attack so light as to have escaped recognition is capable of producing such an immunity. That an immunity can be acquired artificially by means of inoculations of various kinds and in various ways now seems to be an established fact. I need only mention in this connection the pioneer work of the Spanish physician, Dr. J. Ferrán in 1884 and 1885, and after him the investigations of Petri, Brieger, Wasserman, and Kitasato, Klemperer, Klebs, and Hafkine, which with those of others constitute a body of experimental data so convincing as to leave but little, if indeed any, room for reasonable doubt. Whether or not an attack of cholera follow introduction of the

special *contagium vivum* into the stomach of man may depend upon one or more of several conditions. The acid gastric juice of the stomach is, when present in sufficient quantity relative to the number of cholera microbes, capable of quickly killing them. Hence at times when the stomach is properly functioning and the number of the cholera bacilli swallowed is not excessive, there is far less probability of these microbes passing the pylorus alive and still retaining their vigorous pathogenic powers than when either there is little or no acid in the stomach or but little relative to an excessive number of comma bacilli introduced. Then, again, the factor of personal susceptibility —or, if we prefer its complement, we may say the factor of personal immunity—may intervene (after the cholera microbes have passed into the small intestine alive, virulently pathogenic and in sufficient numbers, with certain limitations), either to render an attack of cholera more certain of development and more violent, or to prevent it entirely, or to render it milder, respectively, as the case may be. Thus there is strong reason to believe that in Asiatic cholera as in other infectious diseases, whether the degree of susceptibility or the degree of immunity of any person be great or little, the dosage of the infectious material is a matter of importance for the generation or the violence of an attack. Any degree of immunity can be overwhelmed by an excessive dose, and any degree of susceptibility can be rendered insufficient by too small a dose. These considerations explain why it is that of so many exposed to the infection of cholera only a comparative few suffer an attack which is recognized as such. They also explain why a few foolhardy persons, whose skepticism seems to be greater than their power of discrimination, have ostentatiously swallowed voluntarily, in former times, some of the intestinal discharges of cholera victims, and in later times, some quantities of pure culture of the cholera microbe, and have lived to preach their false doctrine.

When a sufficient number of vigorous pathogenic cholera microbes is introduced into the stomach and passes with vital properties unimpaired into the small intestine of a susceptible person, an attack of infectious cholera may be developed. In such a case the cholera microbes multiply enormously, and often with great rapidity, in the small intestine. With their growth there, under favorable conditions not yet well determined, a virulent specific chemical poison is generated. Whether this poison be essentially a *ptomaïne* analogous to the highly-poisonous vegetable alkaloids, as some contend, or a species of virulent *albumose*, as others maintain, or a special pathogenic *enzyme*, as a few affirm, or possess other characteristics, or be a combination of two or more of these, it would be unprofitable to discuss in this place. Whatever the nature of this specific chemical poison may be, it is pretty certain that when generated in sufficient quantity it attacks primarily the epithelium of the mucous membrane of the small intestine, exciting in it the phenomena of irritation and degeneration in varying degrees—according to the concentration of the poison and the susceptibility of the person—from initial cloudy swelling all the way to complete fatty degeneration and desquamation. The irritant poison penetrates beyond the epithelium and excites in a susceptible person a round-celled infiltration of the connective tissue underlying the epithelium; it may even exert its irritant powers upon the submucous layer of connective tissue, and sometimes its influence may even extend outward into the muscular and subserous coats of the intestine calling forth in them varying inflammatory phenomena. Klebs pointed out that autopsies of rapid cases of cholera showed invariably the inner surface of the small intestine to be covered with a very tenacious coating of mucus, and the experience of most observers confirms him. Another characteristic is that the serous mem-

brane of the small intestine is likewise the seat almost always of a viscid covering, consisting mainly of degenerated and proliferated endothelium. The inflammatory action in the mucous and submucous coats of the small intestine may become so intense as to result in more or less extensive necrosis. Very generally the mucous membrane is hyperæmic. This hyperæmia may be very diffuse or it may be limited to larger or smaller areas. It is usually most marked in the region of the ileo-cæcal valve and around the Peyer's glands. The Peyer's glands and the solitary follicles are usually infiltrated and prominent, and this is so common that some French authors have regarded cholera as a specific psorenteritis. The infiltration of these glands may in some instances be so intense as to end in necrosis and ulceration. Notwithstanding the fact that the chemical poison of cholera attacks locally, first, the intestinal epithelium, and then the subjacent layers of connective tissue, sometimes even to the point of denudation and limited destruction of the latter, the cholera microbe itself never penetrates the coats of the intestine except when they are denuded, and then does not pass beyond the most superficial portion of the exposed connective tissue: it never enters the lacteals or reaches the general circulation. The chemical poison, however, which is produced in the intestinal canal by the growth of the cholera microbes therein, does not limit its action to a local attack upon the intestinal epithelium or upon the subjacent tissues; but it is taken up by the intestinal absorbents or the capillaries of the villi, and enters the general circulation of the blood to be distributed to every organ and tissue in the body, to develop in the susceptible its secondary or constitutional action. It may be said, therefore, that cholera infectiosa epidemica is essentially a specific systemic intoxication. It may not always happen that the whole or the greater portion of the specific poison which produces an attack of Asiatic cholera has been generated within the intestinal canal of the victim; there is strong reason for the belief that exceptionally, at least, the offending material ingested already contains, before swallowing, a sufficient quantity of the specific chemical poison of cholera to produce an attack of the disease. It is probable that at least some of those attacks with a violent onset in a very few hours after exposure to the infection have resulted in such a manner, especially if the autopsy show, as it sometimes does, very little alteration of the intestinal mucous membrane. I can conceive, for example, how milk diluted with water contaminated with cholera dejecta, and then allowed to stand for several hours in a warm place, can act as a quick and fatal poison when swallowed in large quantities. In such a case it would matter not if the bacteria were killed in the stomach by the action of the gastric juice; the preformed chemical poison of cholera when absorbed from the intestine and circulated in the blood might, if in sufficient quantity, still be capable of causing a violent, and even a mortal, attack of cholera. The stools from such a victim of the cholera poison might still contain some quantity of that poison, but could not, in the absence from them of the living pathogenic comma bacillus of Koch, be infectious. In other words, from such a victim a new case of cholera could not arise, much less an epidemic. Furthermore, although the symptoms, course, termination, and post-mortem appearances observed in such a case would naturally be those characteristic of cholera, yet a culture test of the stools would necessarily be negative in result, and therefore misleading as to the origin of the attack, if not, indeed, of its nature. *A priori*, it is just among young children, who consume habitually large quantities of milk, that we should look for the largest proportion of such toxic non-contagious attacks of cholera.

Symptoms.—For convenience of description in part, and in part also

because the common course of the attack furnishes the basis of the division, clinical writers have been in the habit of discussing the symptoms of Asiatic cholera under four periods: *a*, the prodromal period; *b*, that of serous evacuation; *c*, that of algidity or collapse; *d*, that of reaction.

a. The prodromal period, or period of incubation, varies in duration from a few hours to perhaps five days. Probably its average length may be most accurately reckoned at forty-eight hours. It is the time which elapses between the ingestion of the infectious material and onset of pronounced symptoms. During the early part of the period, sometimes during the whole of it, the subject is apparently in his accustomed health, whilst in the latter part of it, and occasionally throughout its entire length, and increasing in severity toward its transition into the next period, there may be a general feeling of distress in the abdomen, or even a tendency to nausea, with or without tenderness, restlessness, rumbling, and increased peristaltic movement of the intestines sometimes visible or palpable through the abdominal walls; laxness of the bowels or decided diarrhœa, with colored semifluid, feculent, or decidedly fluid, usually painless, sometimes copious, evacuations. All of these symptoms may be present, or only one of them, or they all may be absent. There is nothing at all distinctive in their character which is in any way suggestive of their special nature. They excite suspicion only when it is known or suspected that the person may have been exposed to the infection of cholera, or when the disease is present in the locality. There is no indication of systemic intoxication during this period. The cholera microbe has merely reached the small intestine, and is more or less quietly gathering its forces for the active attack. It is engaged in multiplying itself and in generating its specific poison. The assault on the epithelial lining of the small intestine may have actually begun, and some breaches in its integrity have been accomplished; sufficient of the chemical poison may have been generated for the production of some hyperæmia of the mucous membrane, or even for the excitement of some infiltration of the subepithelial connective tissue; but there has been as yet no systemic absorption of the specific chemical poison; the action of the special poison is still local, although there may be experienced a degree of prostration out of all proportion to the diarrhœa present.

b. The period of serous evacuations may be regarded as that of systemic intoxication, and its duration may last from a few hours to a day or two. The prodromal diarrhœa, if it have existed, now usually assumes more gravity. The discharges become more frequent, copious, and fluid. Often, but not always, every trace of color disappears from the stools. The latter now frequently present the well-known rice-water aspect: they are thin, very watery, and hold in suspension more or less minute whitish flakes or shreds in great numbers; they look like a watery gruel, in fact closely resemble the aspect of barley-water or macaroni-water. They may sometimes still be slightly colored, and they are not infrequently frothy or somewhat bloody. In fact, there is many a case of cholera Asiatica where the stools are bilious or lack entirely the familiar rice-water appearance. Often the desire to evacuate the bowels is sudden and absolutely uncontrollable, and the contents of the lower colon and rectum are sometimes expelled with great force without pain and in enormous quantity, saturating the bed and covering, or deluging the clothing if the patient be still up and moving around. Nausea and vomiting are now usual accompaniments. At first the vomit may be bilious; later it assumes the rice-water or gruel aspect. The amount of fluid discharged from the anus and mouth is often excessive. Prostration quickly becomes extreme, and thirst intense. The cry for water is constant, yet it is rejected by the

stomach almost immediately after it is swallowed. The enormous exudation of fluid into the intestinal canal reduces correspondingly the volume of the lymph in the tissues and organs, and of the blood in the circulatory system. The tissues become abnormally dry and shrunken, and the blood markedly thickened. The number of the corpuscles of the blood is relatively much increased per cubic centimetre; it is sometimes nearly doubled. The heart has not of itself the power to propel this thickened fluid with sufficient vigor to prevent venous stagnation. At first the pulse is very frequent for a time; indeed, palpitation may add to the general distress and anxiety of the patient; besides being accelerated, the pulse is usually at the same time small, feeble, and soft. Later the heart's action becomes more and more enfeebled, until the pulse is nearly or quite lost at the wrist, whilst the apex-beat may also nearly or quite disappear, and the heart-sounds themselves decidedly change their character—the systolic sound being greatly weakened, or even replaced by a faint blowing murmur, and the second sound lost entirely. The loss of fluid is shown in the deeply sunken orbits, glazed corneæ, the pinched expression of the face, the wrinkled condition of the palmar surface of the hands and feet—the washer-woman's hands—and the general emaciation, which often becomes extremely marked. The impeded circulation of the blood is evidenced by the more or less lividity, which is most marked around the eyes, the ears, the lips, and the ends of the fingers. The surface temperature sensibly falls below the normal, sometimes markedly; on the contrary, the rectal temperature is usually considerably above the normal. The temperature under the tongue is commonly subnormal, and the tongue itself often feels cold to the touch. Whilst the cutaneous surface is objectively cold, the patient himself will frequently complain of intense internal heat. The voice becomes weak, hollow, and husky. The intellect may be clear or clouded. Sometimes there is great restlessness and jactitation; at other times there may be entire calm and hebetude approaching to stupor. Oftentimes cramps in the extremities and trunk may be absent or mild and fleeting, or they may be so violent as to cause agonizing pain to the patient. In the early part of this period there is marked diminution of urine associated with albuminuria, and frequently, granular tube-casts. Very soon, however, secretion of urine is completely suppressed. While the blood is robbed of chloride of sodium and serum by the exudation into the intestinal canal, it is overladen with urea, which the kidneys fail to remove, and there is proportionately more of its salts in the central nervous system than anywhere else in the body.

We have said that this period should be regarded as that of systemic intoxication. The specific chemical poison elaborated in the small intestine during the enormous multiplication of the comma bacillus of Koch, has at at length been taken up by the intestinal absorbents or has entered the network of intestinal capillaries, and has reached the general circulation of the blood. From this moment the scope of its action is no longer localized in the small intestine, but is now extended throughout the whole system. The presence of this specific poison in the blood of the susceptible, works changes in the complexion of this vital fluid, some of which are readily visible. We have already spoken of the relative increase of the corpuscular elements due to loss of fluid. There is, however, a material change in the red corpuscles, probably due to the effect of the special chemical poison: many of the red corpuscles are much paler than normal, and also much smaller; some have been broken up into very small particles, which by reason of their form and frequent arrangement in pairs and chaplets have been mistaken for micrococci. The specific gravity of the blood is much increased; there is little or

no tendency of the red corpuscles to adhere together, and there is little tendency to the formation of large clots when allowed to stand; if there be any separation of serum, it is very slight. The blood when drawn from the veins is very dark, almost black in color and tarry in consistence.

This abnormality of the blood does not, of course, reach its height at once with the commencement of this stage, but progresses with the continuance and severity of the exudation of the fluids into the intestinal canal during this period. The blood becomes so thick and the heart's action so weak that the flow in the veins becomes exceedingly slow or seems to be arrested entirely toward the end; it sometimes will not flow from an incision. The left side of the heart may contain but little blood, and the large arteries, which are often spasmodically contracted, are nearly empty. The right side of the heart, on the contrary, is full oftentimes to over-distention. The lungs are usually found, post-mortem, to be quite pale, bloodless, and retracted well against the spinal column. In the mesenteries the arteries are much contracted, while the veins are greatly dilated, and there is usually also capillary engorgement. In fact, this condition of strong contraction and emptiness of the calibre of arteries, wide dilatation and fulness of the veins and capillaries, is observable nearly everywhere. There are often also small ecchymoses, and sometimes rather extensive extravasations, particularly at the mucous surfaces. Œdemas, however, are not to be met with; notwithstanding the numerous stagnations of the blood-current in veins and capillaries, the flow of fluids of the blood into the intestinal canal is so great, and the consistency of the blood has become so thick, that everywhere else than at the mucous surface of the intestines the tendency to fluid exudation has been completely arrested. The ecchymoses above mentioned are more abundantly scattered over the mucous and serous surfaces than elsewhere, although they may exist even in the muscular tissue.

The toxic influence of the specific chemical poison in the blood is probably most marked upon the central nervous system (including the sympathetic ganglionic system), and upon the liver and kidneys, especially the latter. The mechanical results of loss of such an enormous qauntity of body fluid may in some part account for the seriousness and severity of the symptoms of this and the following period; but doubtless the action of the chemical poison in the blood upon the nervous system, the liver, and the kidneys is even superior. The first onslaught of the poison upon any important internal organ after reaching the blood naturally falls upon the liver. This organ is generally smaller than normal, flaccid, and anæmic, and contains less glycogen than normal. The outlines of the lobules are more or less indistinct; the interlobular network of blood-vessels may or may not be dilated and filled with blood; the radiating cellular trabeculæ of many lobules are decidedly narrowed, while the inter-trabecular blood-capillaries of some portions of acini are dilated and filled with blood-corpuscles. The hepatic cells of many acini are granular and difficult to stain. Some investigators contend that there is actually some atrophy of the liver. The gall-bladder, the cystic and common ducts are distended with a thin brownish or greenish fluid, whilst the interlobular biliary network is not appreciably altered. Whilst the biliary ducts and gall-bladder are full, the intestinal end of the ductus communis choledochus is usually practically impermeable, and the intestines rarely contain any bile. The spleen is contracted and often flabby. Next to the intestinal lesions in cholera the kidneys show the greatest pathological changes. The effect of the cholera poison in the blood falls heavily upon these emunctories. Granular degeneration of the secretory tubules of the cortex soon becomes marked, but is irregularly distributed at first. After this pathological process has continued for some time,

fatty degeneration of the tubular epithelium becomes general and intense, and associated sometimes with parenchymatous inflammation. The suppression of urine is therefore not alone due to the mechanical effects of thickening of the blood.

c. The period of algidity or collapse may follow after a few hours of continuance of the period of serous evacuations, and may last for some or many hours until death or reaction ensues. In this desperate condition prostration is extreme; the voice is gone; respiration is very feeble, shallow, and fitful; the pulse has vanished and the heart almost ceases to beat; so also the nausea, vomiting, and cramps, the frequent enormous forcible evacuations of the bowels, whilst, instead of the latter, the contents of the intestines dribble away from the anus, whose sphincter is inactive. Profound stupor or coma is the rule. The general lividity is intense; the coldness of the skin is like that of marble. The vital forces are nearly overwhelmed by the great losses of fluid sustained, by the effete substances which are accumulated, and by the special cholera poison. During this period the vital spark flickers very faintly; life hangs trembling in the balance. The pathological conditions are essentially those of the previous period, intensified.

d. The period of reaction may be short or prolonged, and directly follow either of the three preceding. It may last from three or four days to as many weeks. When it follows immediately upon the prodromal period, convalescence is usually rapid and short, and the wonted health is soon perfectly re-established. In such a case there is, after all is over, of course, great doubt that the attack was choleraic at all. The finding of the comma bacilli of Koch in the stools is the only certain criterion of what its true nature has been. When the period of reaction immediately follows the period of serous evacuations, it is usually the more definite the more serious the symptoms and pathological lesions during the latter period have been. If there have been great alterations of the mucous membrane of the intestines, profound general intoxication, with great destruction of the red elements of the blood and marked degenerations in the liver and kidneys, we may expect to witness a more or less prolonged, complex, and dangerous period of reaction. In fact, as a rule, more patients die during than before reaction, when the latter follows immediately the period of serous evacuations. The gravity of the symptoms and general condition of the patient may slowly ameliorate or quickly improve, or one set of alarming symptoms may simply be substituted by another set, which, although not so frightful to the laity, will be regarded by the experienced physician as only a prolongation of the critical struggle between the very evenly balanced forces of life and of death. The evacuations from the stomach and bowels decidedly lessen in frequency and copiousness; the stools lose their barley-water aspect; the bile reappears in them, and they assume gradually the common characteristics of an ordinary diarrhœa, sometimes stained with blood; or if the local destructive effects of the cholera poison have been drastic, there may be grafted upon the diarrhœa a more or less pronounced dysenteric condition with bloody stools and tenesmus. The characteristic aromatic sperm-like odor of the rice-water stools may now change to the foul, stinking odor of decomposition, and the flatulence which was absent during the preceeding period may become annoying. The voice becomes stronger, respiration more steady and fuller. The heart gradually regains its lost powers; the pulse begins again to be felt at the wrist; the surface temperature again goes toward the normal and quickly passes above it; the shrunken countenance begins to discard the Hippocratic expression, the sunken orbits to fill up and the glazed eyes to brighten; prostration becomes less marked,

thirst less intense; the secretion of urine is slowly re-established, at first containing much albumin, granular casts, and large quantities of urea; appetite and digestion are slowly recovered as a rule. In fortunate cases the restoration to health and to the proper exercise of all the bodily functions may be rapid and complete. But in other cases anæmia, due to the great injury to the elements of the blood, may be protracted; or the functions of the much-damaged kidneys may be slow of re-establishment; or the destruction of intestinal epithelium may leave denuded patches in the subepithelial layers of connective tissue, and thus occasion prolonged irritation and even serious derangement of the processes of digestion, and at the same time furnish numerous points of entrance for various septic micro-organisms. In truth, a secondary septic fever, as the result of systemic invasion in this manner, is not at all uncommon in this period: it is vulgarly called the typhoid stage of cholera.

When the patient passes through the period of serous evacuations and that of algidity or collapse, the period of reaction usually differs only in degree from the condition above described. It can be now readily understood why almost as many victims succumb during the period of reaction as during the periods of specific action of the cholera poison. Even after convalescence has been established impaired health may persist for a long time, evinced by chronic anæmia, stubborn disorders of the digestive apparatus, and easily disturbed bowels. Before convalescence is fully confirmed, and even for some time afterward, imprudences of diet sometimes precipitate a dangerous relapse.

Special Phases of Cholera.—In a virulent epidemic of cholera the cases of very sudden and violent attacks, which do not seem to have been preceded either by a prodromal period or the one described in section *b*, are sometimes numerous, and they are most frequently encountered near the commencement of the outbreak. These attacks have been variously named foudroyant, toxic, asphyxic. In description of these foudroyant attacks we cannot do better than quote the recent language of Dr. N. J. Simpson, the health officer of Calcutta: "On these occasions the suddenness of the attack, the number affected, and the virulence of the disease would incline one to think that the specific organisms had already elaborated outside the human body a strong poison which acted on the victim almost immediately after being swallowed. Under the most favorable conditions for the elaboration of such a poison there will not, as far as can be ascertained, be the usual twelve to forty-eight hours' period of incubation; on the contrary, patients will be brought into hospital in a dying state, though taken ill only a short time previously; some will die before reaching the hospital; and the ratio of mortality is likely to be 75 to 85 per cent. The description given by Dr. Jamieson in 1817 seemed to me until some time ago somewhat exaggerated, when the cases seen during an outbreak at a large pilgrimage convinced me of the correctness of Jamieson's accounts as applied to exceptional outbreaks. He says: 'Sometimes there was no vomiting, sometimes no purging, sometimes no spasm throughout, sometimes all these symptoms were simultaneous, and the vomiting and purging took place together, as if caused by sudden contraction of the alimentary canal in its whole extent. In some rare cases the virulence of the disease was so powerful as to prove immediately destructive to life, as if the circulation were at once arrested and the vital powers wholly overwhelmed. In these cases the patient fell down as if struck by lightning, and instantly expired. Others, again, sank after making one or two feeble efforts to vomit and drawing a long and anxious inspiration; some recovered from the insensibility produced from the first shock, and afterward went through the regular course of

the disease.' In these and similar cases a virulent poison is the best explanation of the symptoms and apparent absence of the period of incubation, and of the destructive nature of the disease." Another phase of cholera still more rarely met with is what has been termed *cholera sicca.* In this there is no vomiting, no purging, but the other symptoms may be little different from those already described. The autopsy shows, however, that there has nevertheless been great exudation of fluid into the intestinal canal, for the latter is greatly distended with it from end to end.

Special Complications of Cholera.—I have already spoken of frequent occurrences of ecchymoses, especially on the mucous and serous surfaces. Cutaneous petechiæ and eruptions are not uncommon in the period of reaction; they appear less frequently during that of serous evacuations or algidity. These eruptions, more often observed on the face, neck, and forearms than elsewhere, are usually more or less punctate, the puncta being slightly elevated and having a tendency at times to aggregate into irregular groups. These spots vary somewhat in color, but most frequently the points are dark or black. In some rare cases the vitality of the skin seems to be in a degree impaired, as indicated by a disposition to ulcerate upon small provocation; for example, bed-sores may sometimes develop early and become an exceedingly troublesome complication. The cause of these eruptions is unknown, but if we were to express a mere conjecture, it would be that they may be due to innumerable minute thrombi and emboli—small clots which have formed during stasis of the blood.

Diagnosis.—The differential diagnosis of Asiatic cholera by means of its symptoms alone is, during the absence of an epidemic of the disease, one of the most difficult feats the clinician is ever called upon to perform. Indeed, it is held by some of the most skilful and renowned clinical diagnosticians in the world to be an utter impossibility to make a certain diagnosis; and it is, and always has been, the common experience of the whole world that the saddest, and for the public health the most deplorable, mistakes are very often made even by the most experienced. And yet there is no single one of the whole category of diseases with respect to which a mistake in diagnosis of a first case may, and sometimes does, entail such an endless series of incalculable public calamities. There is not one of the symptoms, and of the groups of symptoms, met with in some period of an attack of Asiatic cholera, which does not perfectly resemble those of some disease which is more or less common. Among these commoner affections for which Asiatic cholera may be mistaken clinically are cholera morbus, arsenical poisoning, pernicious intermittent fever, and poisoning from consumption of various articles of food in special states of decomposition or fermentation.

Of course during the prevalence of an epidemic in a locality, the physician of that place will wisely regard and treat every case presenting the symptoms common in Asiatic cholera as an undoubted case, and will not hesitate to handle it as such; for the community will unquestionably uphold him. It is, however, just when the physician is most uncertain—namely, in dealing with those doubtful cases which precede and follow the epidemic—that the real interests of the community and of the general public demand the greatest certainty of diagnosis; but then, as a rule, the people are unwilling to submit to restraints. Fortunately, through the discovery of Koch in 1883 and 1884, we now possess the means of making an absolutely certain differential diagnosis of cholera infectiosa epidemica, and without reliance upon clinical symptoms, which may be misleading, or upon trustworthy knowledge of the previous history or relations of the patient, which may be difficult or impossible to obtain. The

presence or absence in the stools of the suspect of the comma bacillus of Koch promptly and definitely settles the matter. This can be determined within forty-eight hours by resort to the microscopic and biological tests. These tests, however, should never be relied upon when made by a tyro. They are too difficult of application to be trusted to the inexperienced. To describe here the methods of procedure would therefore be useless, for the experienced bacteriologist does not need such instruction, whilst the unskilled would need much more to be rendered capable. During times of great danger of the introduction of Asiatic cholera into a locality all cases presenting the symptoms of cholera should be handled as suspicious until a differential diagnosis by means of the microscopic and biological tests be made by a thoroughly competent and experienced bacteriologist.

Prognosis.—The outcome of an attack of cholera depends very much upon what period of the seizure medical advice is had, very much upon the slowness or rapidity with which grave symptoms appear and persist, very much sometimes upon the period of the epidemic at which the attack happens, and very much upon the constancy of intelligent care in handling the case from first to last. Wise and prompt treatment of the first stage usually aborts the attack almost in the beginning, and is followed by scarcely any mortality. In the vast majority of such cases the attack never gets beyond the stage of premonitory diarrhœa, and convalescence is usually rapid and complete. The prognosis of a seizure which has passed into the second period, or that of pronounced serous diarrhœa, is grave ; the mortality varies greatly, from 25 to 60 per cent. of attacks, by reason of the varying susceptibility of patients, varying doses of the specific poison, varying promptness, persistency, and wisdom of treatment. The prognosis of an attack of Asiatic cholera in the period of algidity or collapse is truly desperate, and the mortality has usually been frightful, not infrequently having reached 80, 90, and sometimes 100 per cent. The prognosis of an attack which has reached the period of reaction varies greatly according to the damage which may have been done the intestinal lining, the secretory elements of the kidneys, the glandular elements of the liver, and the elements of the blood, and in proportion to the accumulations of effete material and of specific poison in the blood and tissues. It is sufficiently serious to require careful nursing and wise medical direction ; where septic poisoning has been engrafted upon the cholera attack, it is often grave. Speaking generally, the mortality of epidemics of Asiatic cholera is usually greatest in the early course of the outbreak in the locality, and is limited almost entirely to those who neglect to invoke the aid of the physician until the attack has become exceedingly grave. The general mortality among the attacked may vary between 20 and 80 per cent., according to the virulence or mildness of the type of the disease, the total average being nearly 50 per cent. If the patient is seen early and is promptly, judiciously, and *constantly* cared for, the danger of a fatal issue is usually not great.

Treatment.—Although the gross number of attacks of Asiatic cholera and the wide spread of pandemics of the disease among civilized nations have lessened considerably, thanks to better hygiene and improved methods of prevention, yet the percentage of deaths to attacks remains about the same now as it was many decades ago, and is not very materially lower under modern and civilized systems of therapeutics than it has been under antiquated and semi-civilized or barbarous modes of management. Knowledge of efficient methods of treatment of cholera has by no means kept pace with that of the etiology and prophylaxis of the disease. In the early stages of this disease the skilful physician is all powerful ; in the latter stages he is almost

impotent. Hence the paramount advantage of prompt and judicious medical treatment.

Treatment in the Premonitory Period.—During the prevalence of Asiatic cholera in a locality, every disturbance or derangement of the alimentary canal should be corrected without loss of time. Indigestion or abdominal distress should receive without any delay the careful attention of the physician, who should not fail to impress upon his clientèle the urgent necessity of scrupulous obedience to his instructions. The first thing to do is to remove any apparent cause of the disturbance; place the patient upon a lighter diet, fluids by preference; absolutely interdict any exercise which tends to overheat or fatigue; insist upon clothing during the day which will keep the trunk and extremities warm, and, during the night, which will prevent chilling of the abdomen and the legs. One article of clothing should consist of a broad flannel binder around the abdomen and loins next the skin, kept on day and night. The first appearance of diarrhœa should be the signal for active treatment. One or two stools during the twenty-four hours more than the usual number habitual to the individual when in health, or a single copious watery stool, should require the patient to be put to bed at once and kept recumbent, not only during the continuation of looseness of the bowels, but for a day or two after this condition has entirely disappeared. All solid food should be rigidly interdicted, and nothing but broth, bouillon, or whey, allowed to be eaten. In fact, an approach to abstinence is far more desirable than risk of overfeeding. The looseness of bowels or diarrhœa must be arrested as soon as possible, but in doing this it is much better to avoid powerful astringents and strong opiates if it can be done without them. In the choice of the remedy it should be borne in mind that the nature of the disturbance is that of a specific infection of the small intestine by the comma bacilli of Koch, associated with, and greatly favored by, a rather decided alkalinity of the intestinal fluids. The rational treatment would therefore seem to be the administration of some combination of acids, disinfectants, and sedatives. Of the acids which may be employed in proper doses are sulphuric, hydrochloric, lactic; of the intestinal disinfectants, naphthaline, salol, calomel, salicylate of bismuth; of the sedatives, paregoric, Hoffman's anodyne. Aromatic sulphuric acid and paregoric in proper doses may be given and repeated *p. r. n.* This may be alternated or not with naphthaline or salol, alone or in the same powder with salicylate of bismuth, or with naphthaline and calomel together. It will be found in the great majority of cases that this simple treatment will prove effective. Instead of the mineral acids, lactic acid is preferred by many. Dujardin-Beaumetz uses—

℞. Lactic acid . . . . . prts. 10,
Syrup . . . . . " 20,
Tinct. of citron . . . . . " 2,
Water . . . . . " 1000.—M.

Sig. For the adult three teaspoonfuls, with or without 20 drops of paregoric added, at intervals of a half hour, or longer as the case may require.

As a drink instead of water, it is well to use an acid lemonade with a view to lessening the alkalinity or rendering acid, if possible, the reaction of the contents of the small intestine, in order to inhibit the growth therein of the specific microbe. Sulphuric, hydrochloric, or lactic acid—say, one part to the thousand of sterilized water, sweetened—may be employed for this purpose.

Should the diarrhœa persist or increase in severity in spite of the simple treatment above mentioned, recourse must be had without loss of time to more active medication. Stronger anodynes and decided astringents are called for. Chlorodyne may be used, or Lausedat's drops, as follows:

℞. Tr. valerianæ æther. . . . . ℥c.
Tr. opii . . . . . ℥xx.
Essentiæ menthæ piperit. . . . . gtt. v.
Spts. ætheris comp. . . . . ℥c.—M.
Sig. Five to eight drops for a child of six years.

Or something like the following may be tried:

℞. Acid. tannici . . . . . .
Plumbi acetat. . . . . āā gr. iij.
Pulv. opii . . . . . gr. ss.
Oleoresinæ capsici . . . . . gr. ij.—M.
Ft. pil. No. XII.
Sig. One pill every one to four hours, *p. r. n.*, at the age of six years.

On the principle of clearing the bowels of irritants and altering the secretions, some begin the treatment of this period with a large dose of calomel, followed in a few hours by castor oil combined with naphthaline.

Treatment of the Period of Serous Diarrhœa or Systemic Intoxication.—Although such early treatment as indicated above will, as a rule, prove effective in the prevention of full development of an attack, there are some cases which seem to be doomed, in spite of prompt and judicious attention, to advance into the period now under consideration. Moreover, it it is usually not until this period that the physician is called. The conditions now to be contended with are those which have already been pointed out.

For the vomiting and thirst cracked ice and sinapisms to the epigastrium; for the coldness, envelop the whole person in hot flannel blankets, with bottles of hot water next the skin, and immersion in a hot bath for fifteen or twenty minutes at intervals of two to four hours; for the cramps, friction by rubbing with the palms of the hands: if the pain be violent it may be allayed by inhalations of ether; for the prostration and restlessness, cardiac stimulants and nervous sedatives; for the purging, chiefly intestinal antiseptics and correctives; for the loss of fluid, hypodermatic or intravascular injections of saline fluids; as against the special poison in the intestinal canal, irrigation of the colon with large injections of saline fluids.

Among the legion of remedies which have been tried and often been found wanting, the favorite East Indian compound called chlorodyne has been about as useful as any. Lausedat's drops, already mentioned, may take the place of chlorodyne. The remedies mentioned in treating of the prodromal period, especially the acids and antiseptics, may still be useful in the early part of the stage now under consideration. A powder which has been often used in former epidemics to combat coldness, prostration, and collapse has the following composition:

℞. Bismuthi subnitrat. . . . . ʒj.
Plumbi acetat. . . . . gr. iij.
Camphoræ . . . . . gr. ij.
Oleoresinæ capsici . . . . . gr. j.—M.
Divide in chart. No. XII.
Sig. One every hour or two.

Macnamara, the great Anglo-East-Indian authority on cholera, says: "I think water, though urgently demanded by the patient, should be refused (cracked ice is recommended instead). I would restrict the opium to three grains; it is unwise to give more, although we are wellnigh certain that much of it has been vomited. . . . . If the vomiting is very severe, a single dose of twenty grains (for the adult) of calomel will sometimes relieve this symptom. A mixture may be added, each dose of which contains two grains of acetate of lead and fifteen drops of dilute acetic acid, to be taken every second hour, and fifteen drops of dilute sulphuric acid in water every alternate hour, so that the patient should take a draught of first one mixture and then the other every hour. In this way the alkaline stools become acid, and perhaps destroy the cholera organism in the intestinal canal. However this may be, these acids seem to be beneficial in the treatment of cholera. . . . . I believe that alcohol is positively harmful in any stage of cholera."

Unfortunately, in this stage of cholera medication by way of the stomach is always impeded, very often rendered almost useless, sometimes quite impossible of effecting an impression, by reason of the vomiting and the failure of absorption in the intestines. If the little that is not rejected by the stomach succeeds in reaching the intestine, it so often happens that none of it is absorbed; powerful drugs may lie and accumulate in the latter, to cause actual harm when the stage of reaction is ushered in, and with it restoration of the function of intestinal absorption. Neither can ordinary rectal injections of medicine be depended upon, for the same reason. The sluggishness, sometimes practical stagnation, of the little lymph still remaining in the tissues, after the continuous drain of copious watery evacuations from the bowels, usually lessens, often quite nullifies, the customary results of hypodermatic medication. When such a condition arises, as it unhappily too often does, what other resources has the physician left to him? There are still three which, used judiciously and skilfully, are powerful to restore marvellously—at least for a time, sometimes permanently—the suspended functions. I refer to intestinal, to hypodermatic, and to intravascular irrigation.

Enteroclysis, first introduced by the late Prof. Cantani of Naples during the former cholera epidemic in Italy as a means of treating all stages of the disease, consists essentially in irrigating the rectum, colon, and, if possible, also the small intestine, with large quantities of a warm, astringent, antiseptic, sedative fluid. The following is Cantani's formula for an adult:

℞ Boiled water or infusion of chamomile . . 2 quarts.
Tannin . . . . . 1½ to 2½ drachms.
Laudanum . . . . . 30 to 50 drops.
Powdered gum-arabic . . . . . 1½ ounces.

The temperature of this mixture when introduced should be sufficiently above the normal to aid in restoring heat to the body. Of course the quantity injected should vary according to the age of the patient and other circumstances in the judgment of the physician. The best time for administration is immediately after an evacuation.

Hypodermoclysis, also first introduced by Prof. Cantani as a means of treating especially the stages of serous diarrhœa and of algidity or collapse, consists essentially in the introduction hypodermatically of a large quantity of warm saline fluid for the purpose, primarily, of replacing the fluid lost through the intestinal drain; secondarily, of washing out from the blood and tissues much of the effete material and specific poison which have accumu-

lated in them. Cantani's formula for an adult consists of 2 quarts of boiled water, 2½ ounces of pure sodium chloride and a drachm and a half of sodium carbonate. The quantity to be injected each time varies according to age, the apparent amount of fluid lost, and other circumstances. The amount for an adult is one to two and a half quarts. The temperature of the solution when injected should be 100⅖° F., unless that of the rectum be very low, in which case it has been sometimes raised as high as 109⅖° F. The most successful time for resort to hypodermoclysis is at the first indications of insufficiency of water in the body, such as Hippocratic countenance, wrinkling or discoloration of the skin, cramps, coldness, etc.

Intravascular injections of saline fluids, a procedure as old as the history of cholera in Europe, has had a renewed trial during the present visitation of the disease. Injection into veins and into arteries has been practised especially at Hamburg, and each method of procedure has its champions. Some variations in the constitution and proportions of the saline fluid used occur, but the following may be regarded as a standard: sodium bicarbonate 1 part, sodium chloride 6 parts, boiled water 1000 parts. The temperature of the fluid when injected varies according to circumstances from 100⅖° F. to 104° F., more frequently the latter. The quantity administered has sometimes been very considerable, averaging for the adult one to two quarts. The injection may be repeated in a half hour to four hours, as the condition of the patient demands.

Of the relative advantages and disadvantages of the hypodermatic and intravascular irrigations, it may be said that the former is slower and usually more permanent in its action than is the latter. There may occur occasions, however, in the treatment of the algid period, when the matter of time will decide which method shall be tried first. It seems to me that it is mainly in rapidly-sinking cases in that period, that intravenous injection should be given the preference, to be followed at the second injection by hypodermoclysis. The hypodermoclysis has the further advantage of being far simpler of application. Only one skilful person is required for this operation; indeed, the attendants can readily be instructed to perform it very safely in the absence of the physician. On the contrary, the physician requires at least one skilled assistant to safely perform the intravascular injection. In all these operations strict antiseptic or aseptic precautions must be observed.

For enteroclysis there is needed a large fountain syringe with a long flexible tube with a cock, to which a moderately stiff but flexible terminal portion two or three feet long is attached. The tube, quite full of the fluid, must be passed up into the colon and worked along its interior as far as possible; the fluid should be let flow slowly, avoiding very sudden distention of the gut, and should be retained as long as possible.

For hypodermoclysis a fountain syringe with a long flexible tube, furnished with a cock, answers the purpose; with another shorter tube, one end attached to the cock, the other having a needle-pointed canula, a little longer, stronger, and with a somewhat wider calibre than the ordinary hypodermic needle. The tube and canula are first perfectly filled with the fluid, and then the canula is inserted well in between the skin and deep fascia of the flanks, buttocks, or interscapular region. The fluid should be made to flow slowly, allowing fifteen to twenty minutes for the introduction of one quart. The slight tumor should be made to disappear, as it will, by gentle kneading or massage.

For intravascular injections of saline fluids any good transfusion apparatus suffices.

Lavage of the stomach to stop vomiting is a most effective procedure, and sometimes succeeds in arresting this distressing symptom when nothing else will do it. Indeed, it would seem to be a very useful associate of enteroclysis, for it seems that to clear the stomach of the offending rice-water fluid is only second in importance to washing it out from the intestine. Boiled water holding in solution boracic acid has been satisfactorily used for this purpose.

Treatment in the Period of Algidity or Collapse.—In this stage of the disease, where absorption is practically suspended, little is useful beyond enteroclysis and hypodermoclysis or intravascular injections of fluids, and efforts to communicate heat. The vast majority of cases in this stage die in spite of every effort of the physician, but there is certainly more success to be expected of this mode of treatment than of any other at present known.

Treatment in the Period of Reaction.—The treatment in this stage is essentially expectant and symptomatic. Each condition enumerated in the sections on Symptomatology and Etiology will suggest to the experienced the particular line to be followed. One of the most important things to avoid is pointed out forcibly by Macnamara, whom I can do no better than to quote in conclusion: "When reaction comes on, we must be careful not to fall into the error of over-feeding the patient under the mistaken idea of supporting his strength; he will not die of exhaustion if small quantities of milk and arrow root are administered frequently for two or three days, together with warm beef-tea enemas. But enteritis may certainly be induced if food beyond the simplest and smallest quantities be allowed. The patient requires rest and the most careful nursing after a severe illness like cholera."

Prevention.—Whilst the physician is often impotent in the treatment of cholera, in prevention he may be, if he will, all-powerful. It is not our purpose to discuss this subject from the standpoint of a state or community; we shall consider the matter solely from the side of the individual: First, what those ministering to the sick should do to prevent the spread of the disease; second, what the individual who may be exposed to the infection should do to safeguard himself from an attack of cholera.

1. *The Duties of those Attendant upon the Sick.*—I wish to say in the beginning that, whilst there is scarcely any infectious epidemic disease which is so capable as cholera of working great injury in various ways to the community, if the attendants upon the sick are ignorant or careless in applying the principles of prevention, yet there is no such disease which can so easily and certainly be limited to those attacked if only these principles be constantly and scrupulously applied. As I have said elsewhere, Asiatic cholera can be dwelt with and handled with absolute impunity if only the proper precautions be never once forgotten or neglected. There is, therefore, not the slightest danger in administering to the sick if carefulness be the rigid rule. It has already been pointed out that it is only the evacuations from the stomach and bowels of a person suffering an attack of Asiatic cholera that contain the original infection. To promptly and thoroughly disinfect these and everything soiled by them or containing them is to render the spread of the disease from the person attacked impossible. The evacuations should without any delay be treated in one of the following ways: *a*, water that *is boiling* should be poured upon them carefully, so as not to splash, in such amount that the volume of the water is four times that of the evacuations, or a strong solution of potash soap may be used in the same way; *b*, or fresh milk of lime (white wash), of twice the volume of the evacuation, should be poured upon the latter and the mixture gently stirred; *c*, or a similar quantity of a freshly-prepared solution (5 per cent. strong)

of chloride of lime may be used in the same way; *d*, or a similar volume of 5 per cent. solution of carbolic acid may be thus employed. Whichever one of these means be chosen, it is essential that the vessel be immediately covered from the flies and allowed to stand fifteen or twenty minutes before emptying; and it is also essential that the disinfected evacuations be emptied into a pit in the earth, the bottom of which is covered with a layer of quicklime, and be covered immediately with another layer of the same material, care being taken that the location of this pit does not jeopardize watercourses, springs, or wells. Clothing or other textile fabrics soiled by the evacuations should be disinfected as soon as possible. They should be at first soaked in a disinfectant solution—say, a mixture of strong potash soap and carbolic acid of 5 per cent. strength—for an hour or more, and then boiled. It is better to burn bedding rather than attempt its disinfection. The floors of the sick-room should first be sprinkled with chloride of lime, and then mopped over with a cloth moistened in a chloride-of-lime solution. Any article of furniture which may have been contaminated should be carefully disinfected. Finally, it would be well to disinfect the room itself, after all is over, by means of sulphur fumes, 3 pounds to the 1000 cubic feet of space, for eight to ten hours. No one should be allowed in the sick-room except the necessary attendants, who under no consideration should eat or drink in this room. The patient should be fed from a set of dishes which should be disinfected immediately after use, and kept separate from those of the rest of the household; the remains of the patient's meal should be disinfected and destroyed. After handling the patient or anything that he has soiled, the attendants should immediately first disinfect and then carefully wash their hands: this thorough ablution should be performed invariably immediately before eating. After vomiting or an evacuation of the bowels the mouth and the parts around the anus should be wiped with a cloth wet with solution, 1 : 2000, of corrosive sublimate. If convalescence supervene, the patient should be kept isolated for a week, and the stools should be disinfected during that time. If death occur, the corpse should at once be enveloped in a sheet soaked with corrosive sublimate, 1 : 500, and cremated or buried without delay or funeral cortège. Finally, promptly notify health officials of every suspect or known case of cholera.

2. *Individual Precautions for the Exposed.*—No water or milk should be used or consumed, which could by any possibility be contaminated, unless recently boiled. No cold or uncooked food should be eaten which could possibly become contaminated. Such things as salads should be avoided. Unripe or over-ripe fruit should be eschewed. Alcoholic stimulants are pernicious. In fact, excesses of all kinds predispose to an attack. Regularity in eating, sleeping, exercise, and all other habits, contributes to safety. Keep all the bodily functions well regulated; avoid fatigue and chills. The use of a broad flannel waist-bandage next the skin day and night is beneficial in guarding against abdominal congestions. Quickly correct the slightest intestinal disorder.

DIPHTHERIA.

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Diphtheria is an acute, contagious, and infectious disease, the most characteristic and constant feature of which is a pseudo-membranous exudate on, or a superficial necrosis of, a mucous membrane or some part of the skin which has been denuded of its epithelium. Although a comparatively recent disease in this country, it threatens to be the scourge of the large cities. Less than a century ago but few isolated and poorly-understood cases were seen, but the disease has spread very rapidly during the past fifty years, and in New York City alone the mortality from diphtheria and croup has exceeded fifty thousand in twenty-five years. And this number does not include many cases which were reported as deaths from pneumonia, nephritis, heart failure, etc., which were really complications of diphtheria.

There is no guide to the virulence of diphtheria. It is one of the most dreaded, one of the most fatal, and one of the most common diseases of childhood. At the onset it is impossible to say whether the disease will be mild or malignant. A case beginning with high fever and profound constitutional disturbance may go on to a rapid recovery; while, on the other hand, an apparently mild case will grow depressed and weak, and slowly die. Neither does the amount nor character of the exudate give any certain prognosis. Indeed, the clinical symptoms vary to such an extent that many mild cases are not even recognized unless some post-diphtheritic complication ensues; but, although these mild cases may be of small danger to the individual, they are all diphtheria and all equally contagious, and may be the origin of the most malignant ones.

Etiology.—It has been well recognized that certain cases of croupous inflammation are not true diphtheria. This list includes the chronic membranous exudates seen in certain forms of fibrinous bronchitis, cystitis, enteritis, etc., the acute superficial necrosis of the mucous membranes due to direct heat, as a scald, or an intense irritation from the application of ammonia. However, excluding these, there remain many doubtful cases; but modern bacteriological research seems to have solved this problem, and proven beyond much doubt that there are at least two forms of pseudo-membranous inflammation, the one a true diphtheria, due to the Klebs-Loeffler bacillus, and the other, which may include several varieties, a pseudo-diphtheria, due usually to a streptococcus.

True diphtheria is the product of the Klebs-Loeffler bacillus, either alone or associated with other bacteria, and it is primarily a local disease with many secondary manifestations, due to the absorption of the ptomaïnes or poisons which result from the growth of this micro-organism. The following observations seem to establish these propositions as fairly well proven:

1. This bacillus is present, usually in large numbers, in the false membrane

of all typical cases of infectious diphtheria, and is rarely or never found in other inflammations of the mucous membrane of the throat or in the healthy throat.

2. This bacillus is always found at the place of local infection, and never found in the blood or any of the internal organs, even though they may be the seat of marked secondary changes. On the contrary, streptococci and other bacteria may be found in the blood and internal organs.

3. Pure cultures of this bacillus when injected into the mucous membrane of susceptible animals produce a typical diphtheritic inflammation, even to paralyses and organic lesions.

4. Inoculation of animals with the toxalbumin of this bacillus produces the sepsis, the paralysis, the visceral lesions, and all the secondary constitutional symptoms of diphtheria, without the membrane.

5. Clinically, surface diphtheria, without participation on the part of the lymph-vessels, is apt to exhibit little or no fever; the disease does not run a typical course; one attack does not offer security against its recurrence in the future; and whenever the diphtheritic infecting agent finds a foothold on the body—as, for example, by inoculation—it always excites a local affection at the point of entrance; and from this local infection the general infection will develop, the extent and rapidity of which depend upon the anatomical relations of the affected parts, their characteristics, and their power of absorption.

The hypothesis that diphtheria is at first a general disease of the blood, with secondary manifestations on the mucous membranes, is hardly tenable in face of the foregoing facts. The chief arguments brought forward in support of this theory are its similarity to certain of the infectious diseases; its epidemic occurrence; the fact that constitutional symptoms may be present for hours and days before local symptoms are discovered; the marked susceptibility of children; the great disproportion often seen between the general symptoms and the apparently trifling local changes; the multiplicity of the localizations, and the fact that efforts to conquer the disease by destroying the pseudo-membrane with strong caustics have been for the most part without result. However, these observations simply prove that diphtheria may be a general infectious disease, but they do not explain how this infection takes place. Neither clinical observations nor post-mortem examinations have ever been able to present enough facts to settle this question; but, fortunately, modern bacteriological research, with inoculation experiments on living animals, has determined it very conclusively.

Besides true diphtheria, we frequently meet with an allied pseudo-membranous inflammation which cannot be distinguished from it clinically, except that it runs a milder course. Bacteriologically, however, the Klebs-Loeffler bacillus is always absent, and streptococci, and often other bacteria, are found in great abundance, not only in the exudate, but even in the blood and internal organs. The differential diagnosis is very important, as a knowledge of which disease we have to deal with modifies somewhat the treatment, and greatly the prognosis.

Not only do we have a croupous inflammation which is not a true diphtheria, but we can have a true diphtheria in which the membrane covers so little space that there is apparently no fibrinous exudate. This was clearly demonstrated by Jacobi in his article on "Follicular Amygdalitis;" and every observer must have seen cases in which an apparently catarrhal follicular amygdalitis quickly proved itself to be a diphtheritic one, or, after recovery, showed its true nature by a characteristic diphtheritic sequel—a paralysis of some muscle or group of muscles.

Accepting the microbic origin of diphtheria, we must still take into account the many conditions that materially modify the course of this affection, which is one of the most variable and uncertain of all the contagious diseases. It is doubtful if a normal mucous membrane can be infected by the bacillus, and it is certainly true that a lesion favors its development. This also applies to the toxalbumin of the bacterium, large amounts of which can be swallowed without danger by susceptible animals that have healthy and intact mucous membranes.

Age is ordinarily an important factor in influencing the occurrence of the disease; and, though it may occur at any time of life, it is essentially a disease of childhood.

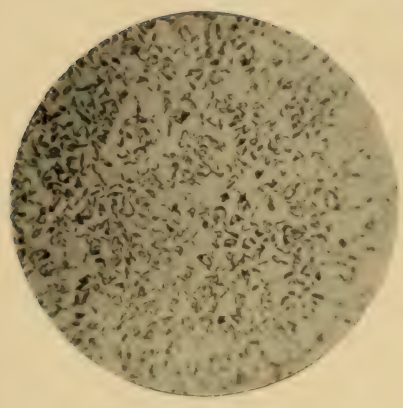
Individual or family predisposition has some influence. It occurs by marked preference in connection with those diseases which produce lesions of the mucous membranes. Cold and dampness favor its occurrence, partly by their tendency to excite catarrhal affections and thus offer an opportunity for infection, and partly by the more favorable conditions for the growth of the bacillus which are present during such weather. All the windows and other sources of ventilation are shut, and the rooms, especially in tenements, where the disease is most common, are stifling and hot. Insanitary conditions undoubtedly favor the development of this germ.

Klebs-Loeffler Bacillus.—In the membrane of true diphtheria this bacillus is always found, either alone or associated with other bacteria. It is rarely or never found in the blood or internal organs, although the streptococcus, which is often associated with it, may appear in the blood, the lymphatics, or the viscera. On the surface and the most superficial portions of the exudate the bacillus is found mixed with numerous other micro-organisms. In the middle or deeper portions the only organisms present are the Klebs-Loeffler bacilli, either alone or associated with streptococci. In the deeper layers there are only a few bacilli, and in the mucous membrane, as a rule, none.

These bacilli are "moderate-sized rods, usually slightly bent, averaging nearly as long as the tubercle bacilli, but twice as broad, and usually with rounded ends. According to the rapidity of growth, the soil, and other conditions, the form and size of the micro-organisms vary, and the differences are striking. The bacteria are sometimes enveloped in a more or less capacious membrane; sometimes the contents divide into a number of pieces, separated by transverse divisions; one end of the rod is frequently thickened like a club, or both ends may be clubbed, or one or both pointed. The bacilli are immobile and have no spores. The best staining agent is Loeffler's alkaline methyl-blue. Some forms stain uniformly, others in various irregular ways, the most common being the appearance of deeply-stained granules in a slightly-stained bacillus or of darkly-stained ends with a paler centre. The bacilli are very often in pairs, never in chains; they are semi-anaërobic, and thrive at a somewhat high temperature, 20° to 42° C."

"The Loeffler bacilli can be cultivated upon all the ordinary culture media, but grow most vigorously on a mixture of blood-serum and nutrient bouillon, as given by Loeffler. On this, solidified, the bacilli grow as large, round, elevated, grayish-white colonies, with the centre more opaque than the somewhat irregular periphery" (Park).

The most ready method of detecting this bacillus is to detach a small piece of membrane and place it for five minutes in a 2 per cent. solution of boracic acid, then to draw the piece of membrane along the surface of sterilized blood-serum in a test-tube, and maintain it at a temperature of 37°

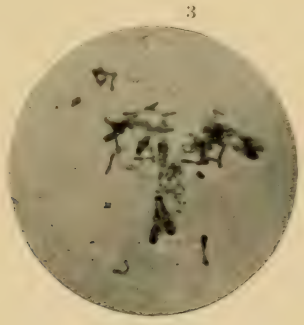


1



2

3



4



A. B. C.

FIG. 1.—Loeffler bacilli. × 650.

FIG. 2.—Pseudo-bacilli. × 650.

FIG. 3.—Involution forms of the Loeffler bacillus. × 650.

FIG. 4.—A. Pseudo-bacillus. B. True bacillus. C. Pseudo-bacillus. (Natural size.)

From photographs taken by Dr. Henry Koplik, Carnegie Laboratory, New York.

C. for twelve to twenty-four hours. At the end of this time, if the bacilli are present, characteristic small white rounded colonies are visible along the track of inoculation. They can then be stained and examined. To get a pure culture a second or third preparation must be made. To overcome the difficulty of obtaining serum for the culture medium, Sakharof suggests the use of slices of hard-boiled eggs placed in sterilized test-tubes, and Johnston suggests the use of hard-boiled eggs from which a part of the shell has been removed with ordinary forceps, so that the shell-membrane can be peeled off and the inoculation made at that point. To guard the culture against contamination, the egg can be placed upside down in a common egg-cup, the interior of which has been sterilized by allowing a flame to enter it for a second or two.

The pseudo-diphtheria bacilli is a term applied to a group of microorganisms which closely resemble the true diphtheria bacilli, both in appearance and in producing a pseudo-membrane, but they are without pathogenic properties in guinea-pigs, and they do not grow on gelatin at ordinary temperatures. However, for bedside diagnosis it is wiser to consider all cases as true diphtheria that give colonies of bacilli resembling the Klebs-Loeffler.

The ptomaïne, or poison, produced by the diphtheria bacillus is of a proteid nature, precipitated by alcohol and soluble in water. When pure, it is a white amorphous mass and extremely poisonous. It is not at all, or but little, absorbed by healthy and intact mucous membranes; but when inoculated into a susceptible animal it produces all the symptoms of a diphtheria without the exudate.

Mode of Infection and Propagation.—There is no doubt that in the vast majority of cases the inoculation takes place through some lesion of the mucous membrane or of the skin. Therefore, it would be hard to overestimate the value, as a prophylaxis, of attention to all lesions, no matter how slight, of the mucous membrane of the upper air-passages. Every catarrhal condition should receive prompt and efficient treatment, and bad teeth, accumulated secretions, or any other source of local irritation should be removed as soon as possible.

The germ is usually propagated through the surrounding air, and brought in contact with the mucous membrane during respiration. Less frequently the disease may be propagated by the direct deposition of diphtheritic matter by inoculation or through some article of food. It has been known to have been communicated from some of the domestic animals. The contagion may be spread by contact with the person or clothes of those suffering from the disease, and may also be spread by bed-clothes, furniture, and other articles in the sick-room. Too much care cannot be taken to prevent those surrounding the sick from spreading the disease, and there is no doubt that physicians themselves frequently carry the disease from one patient to another. This is clearly shown from the large number of cases which occur in their own families.

Incubation.—In experimental diphtheria the duration of the incubation period is short, varying from twelve hours to three days; but when diphtheria is contracted in the usual way—by inhaling air which contains the contagion—this period may be much longer, varying from one day up to twenty. However, in the latter case this only means the interval between exposure and the appearance of the disease, for there is no means of knowing exactly when the contagion entered the mucous membrane, and how long it had remained harmlessly upon it, waiting for the development of some lesion through which to infect it. It is obvious, therefore, that all observations based upon the interval between exposure and the appearance of the disease must be uncertain.

This period also depends not only upon the quality and quantity of the infecting material itself, but also upon the structure and texture of the tissues and their power of resistance—a power which is often greatly modified by streptococci and other bacteria which may be associated with the true diphtheria bacilli. When the Klebs-Loeffler bacilli are implanted upon a normal mucous membrane, they do not grow, but these associated streptococci produce an acute purulent discharge, with redness and swelling. Thus they prepare the lesion for infection by the Klebs-Loeffler bacilli.

Anatomical Changes.—The local pathological changes of this disease occur on a mucous membrane or some abraded portion of the skin. The changes found on the inflamed mucous membrane are as follows: The surface becomes hyperæmic and swollen, and presents the usual manifestations of a catarrhal inflammation. After a short time, usually a few hours, it is covered with a whitish or yellowish layer, which forms the pseudo-membrane so characteristic of the disease. This membrane may represent a fibrinous exudate which can be easily peeled from the surface beneath, or it may represent a true necrosis, so that the exudate is an integral part of the mucous membrane and cannot be separated from it. Many of its characteristics depend upon its anatomical position and the type of epithelium upon which it is located. It looks to the naked eye like coagulated fibrin, but under the microscope it is seen to consist of proliferated epithelial cells held together by a fibrinous network. In its physical and chemical properties it closely resembles fibrin. The surface beneath the exudate may show all grades of inflammation, from a mild catarrhal to an ulcerated one. The false membrane is found oftenest on the tonsils, uvula, soft palate, and back of the pharynx, the nasal passages, the larynx, and trachea; less commonly on the conjunctiva, at the border of the anus, or in the vagina; rarely in the bronchi as a primary affection, but not uncommonly as an extension of the same process from the larynx and trachea; and very rarely in the œsophagus, the intestinal tract, or the ear.

Besides these local pathological changes other organs of the body may become affected as the result of the absorption of the toxalbumin.

The adjacent lymph-nodes are swollen and inflamed, but they rarely become the seat of a suppurative inflammation; the surrounding tissues are infiltrated with serum containing scattered pus-cells.

The lungs show areas of intense congestion, with hæmorrhages into their tissue. They may exhibit œdema, broncho-pneumonia, catarrh, atelectasis, emphysema, ecchymoses, and large infarctions; and the bronchi may be lined with false membrane as far as the smaller branches. These changes, however, are mostly observed as complications of laryngeal diphtheria.

The pleura may be hyperæmic and inflamed, with hæmorrhages, and in many cases the pleural cavity will contain an excess of fluid.

The kidneys, in experimental cases, are moist and hyperæmic, and the adrenals are congested and may be hæmorrhagic. Fatty changes occur in the epithelium of the tubes and glomeruli, and hyaline alterations in the glomerular capillaries and in the smaller arteries. Hæmorrhages, parenchymatous and interstitial nephritis, are common lesions observed in the kidneys in albuminuric cases.

The spleen and the liver may be enlarged and congested, with hæmorrhages into the capsule and tissue. There may be present smaller or larger masses of necrotic cells, and in some cases there is a fatty degeneration, and occasionally, in protracted cases, a hyaline or a waxy one.

The heart may show in the substance of the muscle large and small hæmorrhages and ecchymoses. When death is due to asphyxia without

general poisoning of the whole organism, the muscular substance of the heart itself may be normal; but when there has been a general poisoning it has usually undergone a granular and fatty degeneration, and there may be other septic changes, as, for example, an endocarditis.

In both the parietal and visceral layers of the pericardium there may be small and large hæmorrhages and ecchymoses; there may be an excess of fluid in the pericardial cavity; and in rare cases there may be an emphysema of the pericardium as a consequence of the extension of a subpleural emphysema into the loose cellular tissue between the folds of the mediastinum.

The blood, as in most severe forms of septicæmia and poisoning, is but slightly coagulable, sticky, brown, or rather livid, and the blood-vessels contain a greatly increased number of leucocytes.

The mucous membrane of the intestinal tract and of the bladder may rarely become directly infected, and under such circumstances they present the characteristic pseudo-membrane and other changes which take place in the pharynx, etc. However, when secondary changes occur in consequence of general infection, cell-infiltration and hæmorrhages are the usual ones, and in one reported case such extensive hæmorrhage from the great omentum occurred that a considerable quantity of free blood had collected in the peritoneal cavity. The layers of the peritoneum may be injected and be the seat of ecchymoses, and the peritoneal cavity may contain an excess of serous fluid.

The fibres of the muscles show degenerative changes, and the thyroid may be congested and ecchymotic.

The earliest change in the brain and spinal cord is venous hyperæmia, both in the vascular linings and in the substance itself. Later in the disease come extravasations, with the subsequent softening of the surrounding tissue, and finally various degenerative changes. Extravasations into the substance of the spinal nerves have been seen, as well as granular degeneration of the nerves of the soft palate and other parts that have suffered from a diphtheritic paralysis.

Symptoms and Diagnosis.—The characteristic feature of the disease is the pseudo-membrane. There are cases of pseudo-membranous inflammation which are not diphtheria; but, excluding the chronic cases and those due to great heat, as a scald, and to the application of an intense irritant, like ammonia, it is often impossible to distinguish between the true and the false diphtheria, except by a bacteriological examination. The only positive test is the presence of the Klebs-Loeffler bacillus, either alone or associated with streptococci or other bacteria. In a certain proportion of cases it is very difficult to distinguish between the true and the pseudo-bacillus; and in all doubtful cases, at least for the present or until inoculation experiments can be made, it is wiser to consider them as true diphtheria. Clinically, cases of follicular amygdalitis are frequently diagnosticated as simple catarrhal or purulent inflammations, when they are really diphtheritic. All such cases should be isolated and treated in every respect as true diphtheria until the diagnosis is made certain either by a bacteriological examination or the appearance of new evidence which will show the true nature of the disease.

The diagnosis, even of a membranous inflammation, may be obscure from its location. It may be confined to the posterior nares, the larynx and trachea, or even the intestine, the bladder, or other positions where the local changes cannot be seen.

The constitutional symptoms which are the result of the poisoning due to the absorption of the toxalbumin produced by the specific bacilli vary greatly, and depend not only on the amount and rapidity of the absorption, but also

upon the susceptibility and condition of the patient. In simple and uncomplicated cases there is usually little or no fever. The symptoms may vary from this to evidences of the most profound poisoning. The temperature may be high and irregular, the pulse rapid or, in certain very fatal cases, abnormally slow. There is languor and loss of appetite, and an amount of prostration out of proportion to the fever and the local inflammation; the skin dry and hot; and, according to circumstances, typhoid symptoms may show themselves, or there may be delirium with great restlessness. Relapses are frequent, and one attack does not protect against a subsequent one.

The lymph-nodes which are in anatomical relation with the local process, as well as their surrounding tissues, may be swollen and tender, but they seldom undergo a suppurative change. The degree of enlargement and inflammation depends upon the amount of absorption, and of course this depends not only upon the character of the local process, but also upon its relations with the neighboring lymphatics.

The heart's action is usually rapid, and may be feeble, during an attack of diphtheria; and this condition often continues for some time after the disappearance of all local evidences of the disease. The pulse may be irregular both in force and rhythm. Another condition, usually appearing late in the disease, and often when the local process is apparently improving or has entirely cleared up, is for the feeble pulse to become progressively slower until the beats number less than forty, sometimes less than thirty, to the minute. These cases, which are nearly always fatal, together with those having the feeble, rapid pulse of profound sepsis and exhaustion, may be classed as examples of slow heart failure. But there is still another condition which usually appears after all the alarming symptoms are gone; that is, a sudden failure or paralysis of the heart. Endocarditis most frequently involving the mitral valve may occur, and is accompanied by fever, præcordial pain, attacks of syncope, a systolic murmur, and ante-mortem heart-clots, which may become free and enter the circulation, producing the usual phenomena. In most cases there is a rapid destruction of the red corpuscles of the blood, and a relative increase of the white corpuscles. Hence the anæmia which appears early and rapidly increases as the disease advances.

Albuminuria is a common complication, and appears usually on the third to sixth day, but may rarely appear as early as the first day or as late as the fifteenth. The amount of albumin varies greatly, from a slight cloudiness, on boiling, to complete consolidation. The urine usually appears normal, but it may be scanty and dark, and in rare cases dark-colored or smoky from the presence of blood. There may also be present in the sediment granular, hyaline, epithelial, and blood casts. The duration of the renal complication varies from a day or two to a week or two, but it may occasionally become chronic. It is seldom attended with œdema, but vomiting and other uræmic symptoms are not so rare. It is impossible to distinguish between the albuminuria of true and of false diphtheria, but in diphtheria there are some characteristics which distinguish it from the same complication of scarlet fever.

The tonsils are the most frequent location of the disease, and when confined to them it runs a mild course, because they have little or no connection with the lymphatic system, and they do not contain a large number of blood-vessels. The chief difficulty in diagnosis is to distinguish between a simple follicular amygdalitis and a diphtheritic one. The secretion from a catarrhal amygdalitis may cover the tonsils with a coat which closely resembles pseudo-membrane, but it can be easily washed away with a syringe, and in most cases a careful examination will show its true character.

The pharynx, soft palate, and mouth may be involved; and here it is a more serious condition than when confined to the tonsils. The lymph-vessels are very numerous: those of the uvula connect with the deep facial glands; of the tongue, with the deep cervical and the submaxillary glands; and of the floor of the mouth, with the submaxillary glands. The differential diagnosis lies between true diphtheria and false diphtheria, exudates as the result of an intense heat or irritation, ulcerative and gangrenous stomatitis, or occasionally herpes and aphthæ. The main differential symptoms pointing to diphtheria are, besides the history, the characteristic pseudo-membrane, the thin, brownish, acrid discharge, the sweetish and musty fetor, the glandular swellings, the tendency to hæmorrhages, the slight fever and marked prostration, the albuminuria, and the sequel of paralysis. In doubtful cases the only positive demonstration is the presence of the pathognomonic bacilli.

In the nares diphtheria is very serious on account of the abundant lymph- and blood-supply, and the consequent increased facilities for absorption of the poison, and on account of the conformation of the nasal passages, which interferes with their thorough drainage when swollen and inflamed, and which makes thorough local treatment very difficult. The greater supply of lymph-vessels is in the inferior portion of the nasal cavities, and these vessels connect with the deep facial and posterior submaxillary glands. It is often very difficult, and may be impossible, to see the pseudo-membrane in the posterior nasal cavities in children. Theoretically, it is very simple to use a rhinoscope, but practically it is quite another matter, and it is often impossible and usually impracticable, even in a tractable child. The symptoms which help to a diagnosis are the thin, acrid discharge more or less stained with blood, the evidence of nasal obstruction, the enlarged cervical glands, the bad odor to the breath, the tendency to hæmorrhage, and the frequent signs of general poisoning.

When the epiglottis, larynx, and trachea are involved, the main danger comes from the mechanical obstruction to respiration and the extension of the disease to the bronchi. Constitutional symptoms are usually absent, partly on account of the protection afforded by the very numerous mucous glands, and partly on account of the absence of lymphatic glands and the scant supply of lymphatic vessels. These vessels connect with the bronchial glands. After death from laryngeal diphtheria these glands are found more or less enlarged.

The diagnosis by means of the laryngoscope would be very valuable if it were practical. In the vast majority of cases it is not only impossible, but it is unnecessary and cruel. There is undoubtedly a membranous laryngitis which is not diphtheria, but the differential diagnosis cannot be made either from the symptoms or the character of the membrane. It can only be made by a bacteriological examination, which will show the presence or the absence of the Klebs-Loeffler bacillus.

The differential diagnosis lies between a membranous laryngitis and a catarrhal or a spasmodic one; and while this is not usually so very difficult, certain cases will present phenomena which keep the diagnosis obscure, unless the membrane is actually seen through the laryngoscope or is coughed up. Again, cases which, in the beginning, are catarrhal and run a typical course, may later become infected and run the usual course of a membranous inflammation. Again, confusion may be caused by those rather rare cases in which the membranous inflammation begins below and ascends to the larynx.

In the uncomplicated cases of membranous laryngitis, excluding the ascending ones, there is little or no fever; the onset of the disease is gradual, and it grows progressively worse; there is hoarseness, and after a time complete

aphonia; the stenosis is, at first, slight and only on inspiration, but after a while, usually two to four days, the stenosis becomes extreme, and attends both inspiration and expiration; the respiration and the cough, which in the beginning may be noisy and croupy, gradually become more husky and suppressed. Spasmodic attacks may occur in connection with the disease, but this is not a prominent feature of its clinical history.

The cases of ascending diphtheria of the trachea and larynx are very fatal, and, fortunately, uncommon. There are no constitutional symptoms, and the only evidence of sickness which can be detected is a slight bronchial or tracheal catarrh, until the process reaches the subglottic division of the larynx or the chink of the glottis, when laryngeal symptoms are seen, and stenosis appears and increases so rapidly that the patient becomes cyanotic within an hour or two, and soon dies unless immediate relief is given by intubation or tracheotomy. Even after operative interference the patient, in most cases, dies from extension of the disease to the bronchi, and usually within two days.

In doubtful cases the appearance of membrane in other locations, or the existence of an epidemic of diphtheria, favors the diagnosis of a membranous laryngitis. If with this the temperature is low, not high; the stenosis increases progressively, not spasmodically; the onset is gradual, not sudden; the laryngeal symptoms are of long, not short duration,—the diagnosis of membranous laryngitis is very clear.

There are numerous evidences of stenosis of the larynx besides the noisy respiration, as this latter symptom may be present in many other conditions. The most characteristic features of laryngeal obstruction are the deep recessions of the soft parts of the chest in inspiration, the blue or leaden hue of the skin and mucous membranes, the aphonia, the restlessness, and the abnormal frequency of the respirations; but none of these symptoms are constant. The soft parts of the chest-walls may project and make the chest barrel-shaped if the obstruction is greater on expiration; the skin and mucous membranes may appear blue if the stenosis increases rapidly, but this color becomes a leaden white if the obstruction is of slow progress; the voice may be clear in subglottic cases; and in advanced cases the restlessness is supplanted by a condition of stupor from carbon-dioxide poisoning. The only constant and reliable guide as to the presence and the amount of laryngeal obstruction is obtained by auscultation of the chest and listening to the respiratory sound. This gives an accurate guide as to the amount of air entering the lungs.

The other diseases which should be considered in making a diagnosis are abscess of or about the larynx, tumors of the larynx, retropharyngeal abscess, certain cases of naso-pharyngeal obstruction, foreign bodies in the air-passages, etc.; but the diagnosis should not be difficult if a careful examination is made.

In the bronchi a membranous inflammation is rarely or never primary, but is secondary to a similar one in the larynx or trachea. It may extend to the finer bronchial tubes, or even into the air-cells themselves, and result in a bronchopneumonia, with pulmonary collapse or emphysema. Its symptoms are, in a case of laryngeal diphtheria, a sudden rise of temperature—often very high—rapid respiration, marked dyspnœa, and cyanosis; and, although the physical signs in the chest are often obscure and masked by the laryngeal disease and pulmonary complications, there is less air entering the lung on the affected side, and the respiratory sound is dry and "boardy."

Diphtheria of the conjunctiva, the ear, the intestinal tract, the genito-urinary organs, abraded portions of the skin, and wounds has occurred, usually

as a secondary process, but occasionally as a primary infection. The symptoms are those of an ordinary inflammation in those parts, to which are added the pseudo-membrane and other characteristics of this disease.

Diphtheria may, of course, complicate any disease, but the most frequent association is with scarlet fever, measles, and those diseases which present a catarrhal condition of the mucous membranes, and thus favor a fresh infection.

The skin eruptions which occur in diphtheria are septic manifestations, and may be of three kinds. The mildest and most transient closely resembles a scarlet-fever rash, but disappears more rapidly and does not desquamate. The second type is a purpura hæmorrhagica, and is usually associated with septic and grave forms of the disease. The last type, also seen in scarlet fever, usually follows a purulent septic infection, and occurs in cases which have a high mortality. There is an increase of temperature and the invasion is gradual. The eruption appears as red or dark-pink blotches, with sharply-defined margins. The color fades on pressure with the finger, but quickly returns. It appears first over the prominent bony points, such as the ankles, finger-joints, elbows, outer sides of the feet, etc., but always has a tendency to become general. Its disappearance is followed by a profuse desquamation, and usually this is quickly followed by a return of the eruption.

Sequelæ.—Besides the chronic catarrh which is left at the site of the pseudo-membranous inflammation, and the anæmia, the most frequent and characteristic sequel of diphtheria is paralysis, which develops from one to five weeks after all evidence of the acute disease has gone, though it may make its appearance during the course of the primary affection. It is a true multiple, peripheral neuritis, and resembles very closely, both clinically and pathologically, the neuritis of alcohol, lead, and other poisons. The duration of the paralysis usually varies from two to six weeks; it may last several months, and in exceptional cases has persisted for years. It is more frequent in adults than in children, and the severity of the original disease seems to offer no guide as to the severity of the paralysis or the probability of its appearance. Recovery usually takes place, and, while the location and the order of involvement differ greatly, the course is usually as follows: The soft palate and pharyngeal muscles, giving a nasal tone to the voice and a tendency to regurgitation of food through the nose during deglutition; the muscles of the tongue, lips, and face; the ocular muscles, as shown by strabismus and disturbances of vision; the lower extremities; the upper extremities; the larynx, recognized by modifications in the character of the voice or by obstruction, usually on inspiration; the muscles of the neck, with inability to control the position of the head; the muscles of the trunk, with loss of power over the body; the intercostal muscles, the diaphragm and other muscles of respiration, with interference with their function; the heart, usually fatal, but may not be; the walls and the sphincter of the intestines or bladder. There has also been observed paralysis of the special senses, giving temporary amaurosis, deafness, and impairment of taste and smell.

The paralysis of diphtheria may be divided into two classes; first, a true multiple neuritis, with loss of tendon reflexes as the result of poisoning by the toxalbumin; and second, other types of paralysis, as a result of hæmorrhages or degenerative changes in the brain or spinal cord. The first type occurs only in true diphtheria; the second may occur in true or false diphtheria or as a result of many other septic conditions.

Prognosis.—The prognosis is always better when the Klebs-Loeffler bacillus is absent. In 159 observations on cases of pseudo-membranous inflammation

made by Park at the Willard Parker Hospital of New York, the Loeffler bacillus was found in 54 cases, and in the other cases streptococci were the most abundant bacteria, and often the only ones. The mortality in true diphtheria was 46½ per cent.; in pseudo-diphtheria, 5⅔ per cent.; intubation in diphtheria, 71½ per cent.; intubation in pseudo-diphtheria, 28½ per cent.; adults in diphtheria, 36 per cent.; adults in pseudo-diphtheria, 2 per cent.

The prognosis varies, not only according to the age and condition of the patient, to the symptoms, and to the anatomical location of the disease, but also according to the character of the prevailing epidemic. The danger is greater the larger the surface involved and the more the exudate approaches a septic or gangrenous type, as shown by broken-down masses of exudation, the sweetish foul odor from the mouth, the yellowish or brownish secretion from the mouth and nose, which is both fetid and acrid, and the swelling and tenderness of the lymphatic nodes and the surrounding cellular tissue. However, the prognosis must always be a guarded one, since the subsequent course of the disease can never be predicted; and even after it has apparently terminated in recovery a relapse may take place, the infection may extend to the larynx or nose, or sudden death may result from paralysis of the heart. Another class of cases result in death, after all local manifestations of the disease have disappeared, from a slow exhaustion. Such a condition might be called diphtheritic marasmus, the chief characteristic of which is the distaste for all food and the progressive and extreme emaciation.

The prognosis in nasal cases is more serious, for reasons already given, while in laryngeal cases the prognosis is very grave from the great danger of asphyxia; and, even if this be overcome, from the ease and frequency with which the membranous inflammation extends into the bronchi.

Unfavorable prognostic signs are pallor, prostration, vomiting, hæmorrhages, marked weakness of the pulse, with excessive rapidity or slowness, fetor, purpura hæmorrhagica and septic blotches on the skin, persistent high fever, restlessness, delirium, and anorexia. The importance of albuminuria depends upon its character and the gravity of the symptoms which are associated with it. Diphtheritic paralysis usually ends in recovery, and is dangerous only when it involves the heart or the muscles of respiration or deglutition; and even in these cases its danger depends upon its degree.

Prophylaxis.—The first requisite, after the appearance of the disease, is complete isolation of the patient, either in a hospital devoted to contagious diseases or in a separate room in the house, preferably on the top floor, and containing as little furniture as possible. Separate dishes and other utensils should be kept for the sick-room, and everything that it is necessary to return to other parts of the house should be thoroughly disinfected before it leaves the room. All discharges should be received in vessels containing a strong solution of copperas or corrosive sublimate. The clothing, towels, etc. should be put in a solution of sulphate of zinc (4 ounces) and common salt (2 ounces) in boiling water (1 gallon). Water-closets, privies, etc. should be liberally treated with copperas solution (1½ pounds to the gallon). During the continuance of the disease it is of great service to keep the room filled with some antiseptic vapor, as carbolic acid, eucalyptus, or turpentine; but I have found that most good in preventing the spread of the disease is obtained by subliming fifteen to thirty grains of calomel in the room every hour. After recovery the patient should be thoroughly cleansed and disinfected, and dressed in clothes that have not been exposed to infection. In any event, as much as possible of the exposed clothing, furniture, etc. should be destroyed, and the rest thoroughly disinfected, either by the methods previously described or by naphtha or super-

heated steam. The walls, bed, and furniture should be washed with a strong solution of corrosive sublimate, and then, after closing the room tightly, sulphur should be burned in it in the presence of an excess of moisture—about three pounds of sulphur to every thousand cubic feet of air-space. After this it is well to advise that four to eight ounces of calomel be sublimed. Other members of the family should be kept from school and church; they should be removed to a different house if possible, away from the infection, and their naso-pharyngeal cavities and teeth should be kept clean by means of antiseptic washes, sprays, and gargles. At all times, and especially during an epidemic or after exposure to it, the mucous membrane of the respiratory tract should be kept in as healthy a condition as possible by keeping it clean and free of lesions.

The physician should protect his clothing as much as possible on entering the sick-room by a linen gown, and before seeing another patient, especially a child, all parts exposed to the infection should be thoroughly aired; or, better still, he should disinfect himself and put on fresh clothes, leaving the discarded ones exposed to the open air or to the fumes of subliming mercury.

One of the chief causes of the spread of diphtheria in New York City is the laxness, and almost criminal carelessness, of the authorities in our dispensaries for the poor. It is almost a daily occurrence in the large dispensaries for a contagious case to be packed in a small, hot room with a number of other children, most of them ill and in good condition to contract the infection.

Treatment.—There is no disease in which a greater variety of treatment has been recommended—from the expectant, which lets the patient absolutely alone, to the active treatment, which requires him to be disturbed every few minutes. It is impossible to lay down any routine plan: we have no specific for the disease, and each case should be treated on general principles and according to its individual indications. The general condition and strength of the patient should be improved as much as possible. There should be plenty of sunlight and fresh air in the sick-room, which should be kept at a uniform temperature of about 70° F. The clothes and bed-linen should be kept clean and pure by frequent changing. The skin should be kept in good condition, and special care should be taken of the digestion and nourishment. Great stress should be given in advising the recumbent position and avoiding all exertion, but, of course, this is often impossible in children.

Internal Treatment.—Alcohol and food are of the greatest value, and too much stress cannot be laid on the importance of their proper use. The diet should, as a rule, be a liquid one, and consist of such food as is easily digested. Cows' milk, pure and fresh, is undoubtedly the best, but to aid digestion or to prevent souring and other fermentative changes it may be peptonized, or lime-water or an antiseptic may be added to it. To give variety to the diet or to meet special indications other wholesome and nourishing articles may be included, as beef juice, eggs, etc. The food should always be given at regular intervals, about once every three or four hours, and in definite quantities. It is always harmful to compel a child to take more food than it can digest, and any drug which interferes with the proper digestion and assimilation of the food is positively harmful, and its use should be avoided.

Alcohol, as brandy, whiskey, champagne, wine, or in some other form, should be given rather freely from the beginning, and there is more danger from giving too little than too much. A three-year-old child can take from one to ten ounces of whiskey in twenty-four hours, and in bad septic cases this amount may be greatly increased with advantage. Other valuable stimulants are carbonate of ammonium, camphor, musk, strychnia, digitalis, and the large

number of heart stimulants and tonics; but alcohol, in one of its many forms, is by far the best and safest.

The remedies which are given internally in the treatment of diphtheria make a long list, but most of them are of doubtful value, and many of them interfere with the digestion or do positive harm in other ways. Tincture of the chloride of iron is the most popular one. Locally it is a powerful astringent and antiseptic, but internally it seems to me that the theoretical benefit which it produces is, in many cases, more than counterbalanced by the digestive disturbances which follow its use.

Chlorate of potassium has an excellent effect in healing lesions of the mucous membranes, but internally, especially in large doses, it is positively dangerous, not only by its irritating effects on the stomach and intestines, but also by its dangerous action on the kidneys and heart.

The mercurials, especially the corrosive and the mild chloride, are undoubtedly valuable, but most of the good resulting from their use is obtained from their local effect on the pharynx, and their local effect in the digestive tract by preventing fermentation. The corrosive sublimate should be used in large and frequent doses, and always well diluted.

Turpentine, chloride of ammonium, iodide of potassium, antimony, the salicylates, bromine, benzoate of sodium, balsam of copaiba, cubeb, quinine, pilocarpine, and many other drugs are enthusiastically advised by different writers; but in the light of recent knowledge of this disease it is difficult to understand how any benefit could be obtained by their internal administration.

High fever should be reduced by sponging and baths, and the antipyretic drugs, antipyrine, acetanilid, phenacetin, etc., should be avoided, because they all increase the depression of the weak and degenerated heart. The bath, if used, should not be cold, but begun at 95° F. and gradually reduced to 80°, or even 70° in bad septic cases. Stimulants internally, hot applications to the extremities, and a warm sponge-bath are valuable in overcoming any bad effects of an over-cold bath. However, it is seldom wise to reduce the temperature of the bath below 70° F., and the best antipyretic effects are obtained in this manner. The patient should remain in the bath until the temperature, taken in the rectum, begins to fall, when he should be immediately removed and put to bed. In laryngeal cases, and in cases with enlarged and tender lymphatic glands, cold applications, and even the ice-bag, often seem to be of benefit to the local process.

Exhaustion, reflex vomiting, collapse, diarrhœa, hæmorrhages, and other complications should be treated symptomatically and promptly; but their appearance can often be prevented, and every effort should be made to attain this end. For exhaustion and collapse alcohol in large doses, both by mouth and under the skin, is the best remedy, but digitalis, nitro-glycerin, strychnine, camphor, and musk are useful. In the rapid heart failure of diphtheria, with an irregular and fluttering pulse, nothing is equal to a moderately large dose of morphine, given hypodermatically. It is a powerful stimulant, and quiets and steadies the heart. For the reflex vomiting there is nothing more satisfactory than the oil of wormwood, given as follows:

℞. Olei absinthii . . . . . gtt. j to ij.
Sodii bicarbonatis . . . . . ʒj.
Aquæ menthæ piperitæ . . . . . ad fʒiv.—M.
Sig. One teaspoonful for a child three years old, every half hour until the vomiting ceases. Shake well before using.

When the vomiting is due to uræmia or to irritation of the stomach other appropriate measures should be taken. For the diarrhœa, when due to local irritation in the bowels, give an active cathartic, by preference calomel or castor oil, to remove from the digestive tract the cause of the irritation, and follow this by an antiseptic to prevent further fermentation. The following answers very well:

℞. Hydrargyri chloridi corrosivi . . . . . gr. j.
Bismuthi subnitratis . . . . . ʒiv.
Aquæ anisi . . . . . fʒiv.—M.
Sig. One teaspoonful in water every two hours until the discharges are black and lose their fetor. Shake well.

In severe hæmorrhages, especially from the nose, it may be necessary to apply local astringents or even to plug the nares with cotton. However, this should be avoided when possible, and many cases, being caused by an irregular and weak heart or a passive congestion from a weak right ventricle, can be stopped by the use of alcohol, digitalis, or nitro-glycerin, according to the indications.

Local Treatment.—It must be acknowledged that the best and most satisfactory results in diphtheria are obtained by local treatment. The chief points to be considered in deciding upon a plan of treatment are—

1. *The most convenient method of applying the medication*—by spray, irrigation, insufflation, gargle, inhalation in the form of vapor, or by direct application with a swab. This will vary according to the medication employed and the location of the disease. For naso-pharyngeal cases the most satisfactory and thorough method is by irrigation with a fountain syringe. Through the nostrils the whole naso-pharyngeal cavity can be most thoroughly cleansed, and with less difficulty than by any other method. The child should be kept in a horizontal position when possible, and a rubber sheet arranged to catch the discharge. At each irrigation it is necessary to use enough of the solution to thoroughly clean the naso-pharynx—about one pint. This should be done every two hours, and in all cases often enough to thoroughly clean the diseased surface and bring the germicide in direct contact with it. In adults it is very satisfactory to use the irrigation through the mouth. In children this is often impracticable, but, when necessary, pass the nozzle of the syringe back between the teeth and cheek, so that the stream will enter the pharynx behind the last molar tooth. If the child be intractable and exhaust himself to a dangerous degree by fighting against the treatment, it may become necessary to clean the surface by giving internally plenty of water, either alone or with a weak antiseptic or a mild alkali, and applying the germicide by inhalation in the form of vapor, either by the sublimation of fifteen to forty grains of calomel every hour or two, or by keeping the air of the room saturated with steam which is impregnated with turpentine or some of the volatile antiseptics. The following is an excellent combination:

℞. Acidi carbolici . . . . . fʒj.
Olei eucalypti . . . . . fʒij.
Spts. terebinthinæ . . . . . fʒviij.—M.
Sig. Add a tablespoonful every half hour to about a quart of water, which is kept simmering over a flame.

In laryngeal or bronchial cases, although an application may be made

directly to the larynx with a swab, the only satisfactory method is by means of the inhalation of a medicated vapor.

The spray, while of value, usually does not go beyond the oral cavity, and seldom or never reaches the posterior pharynx. Through the nose it does better service. The swab, except in very careful and experienced hands, is liable to be too harsh and tear off membrane, thus opening up fresh avenues for infection; and in the grave cases, the nasal ones, it is almost useless. The use of the gargle is limited to adults and older children, it is not thorough, and it tires the patient very quickly.

2. *The medication to be employed.* There are two indications to be met: (*a*) the clearing away of débris and dead tissue, which may be the cause of much fetor and secondary septic complications, and which may also prevent the germicide from reaching the bacilli; and (*b*) the destruction of the living bacilli and other bacteria which are producing the disease. A third indication would be to neutralize or to destroy any of the unabsorbed toxalbumin which may be present. With our present knowledge of the properties of this poison it would be difficult to decide upon any practical rules, but we may be sure that its mechanical removal by irrigation is of value. We know that it is taken up very slowly from the infected tissues, often giving symptoms of fresh absorption after all the bacilli have disappeared; therefore the importance of keeping the surface of the mucous membrane clean after all evidence of the disease has gone.

(*a*) The most efficient drug for the removal of broken-down membrane, dead tissue, pus, and other débris is the peroxide of hydrogen, although it has apparently no destructive effect on the living bacilli. For this purpose it is certainly superior to any other means, although there are some preparations which are of great value as adjuncts—*e. g.* a saturated solution of borax in hot water, and the solvents, like pepsin, trypsin, and papayotin. The ordinary fifteen-volume solution of peroxide should be used, either in full strength or diluted with lime-water, which removes some of its acrid and irritating qualities without impairing its efficiency. It should be used freely, and in most cases a mixture of one part of the ordinary fifteen-volume solution with two or three parts of lime-water is effective. The best method to apply it is by irrigation with a fountain syringe, using about half a pint each time, and often enough to keep the diseased surfaces clean. There are several objections to its use. One is the difficulty of obtaining a fresh and active solution. This objection has been, in a great measure, overcome by Squibb of Brooklyn, who has made it possible to freshly prepare this solution at the time of use. A serious objection to Squibb's method is the long time required to prepare the solution. However, it is always well to test the activity of the solution before depending upon it. Another objection, and an important one, is its irritating effect upon the mucous membrane. It causes pain, and, as a result, objections to its use on the part of the patient; it also produces fresh lesions in the healthy mucous membrane, thus offering new places for infection. In my early experience with the drug, these objections and the greatly increased number of cases in which the diphtheritic process extended to the buccal mucous membrane, the gums, the tongue, and lips, seemed to make its use of very doubtful value, and probably harmful. However, these faults can be obviated in a great degree by diluting the solution with an alkaline water, and, after its use, by irrigating the same surface with a saturated solution of borax in hot water. If it is desirable to use the solution of peroxide without diluting it, neutralize the excess of acid with an alkali.

(*b*) To destroy the bacilli almost every caustic, astringent, digestive ferment, essential oil, and germicide has been lauded, and brilliant results claimed for each. Unfortunately, most of these reports are not based upon enough observations to be of much value; and it is apparently not recognized that nearly every case of tonsillar, most cases of pharyngeal, and many cases of naso-pharyngeal diphtheria recover under any kind of treatment.

Of all the germicides, the mercurials seem to have the most destructive effect on the Klebs-Loeffler bacillus, and carbolic acid, either alone or combined with eucalyptus and turpentine, on the streptococci and other bacteria which produce the false diphtheria. As it is often so difficult to distinguish between them—and, in fact, both forms are so frequently combined—it is better to use locally both the carbolic acid and some mercurial preparation. Therefore, always keep the room moderately filled with steam that is impregnated with the mixture of carbolic acid, eucalyptus, and turpentine. In naso-pharyngeal cases, after the thorough cleansing of the surface with the peroxide and the borax solution, use in the cavity a solution of bichloride of mercury, 1 : 1000, either by irrigation, with a swab, or by spray. No metallic utensils should come in contact with the mercury solution, as it corrodes them. If, for any reason, it is impossible to use the irrigation or spray, the local effect of the mercury may be obtained by subliming the mild chloride and allowing the child to inhale the fumes.

In laryngeal cases dependence must be placed upon inhalation, as it is impracticable and dangerous to use the laryngeal applicator. The inhalation most destructive to the Klebs-Loeffler bacillus is the fumes obtained by subliming calomel. The child should be well wrapped up, so that only the face is free, thus exposing the least possible surface of the skin to the action of the mercury. It should then be placed in an ordinary croup-tent, and the calomel sublimed in such a manner as to fill it with the fumes. The best apparatus for this purpose is the ordinary steam-spray, in which the boiler is replaced by a strip of tin upon which the calomel is put. Another good arrangement is to put a small alcohol lamp in the bottom of an ordinary chamber, and cover it with a pie-pan or strip of metal to hold the powder. The same end may be attained with a hot stove-lid, a shovel of red-hot coals, and in other ways. According to circumstances, fifteen to forty grains of calomel should be burned in this manner every one, two, or three hours. It is not necessary to wake the child for treatment, and if the smoke causes much coughing and irritation, sublime it less rapidly by lowering the flame of the lamp. It usually takes about ten minutes to sublime fifteen grains, and if care be taken to obtain pure calomel, or, better yet, calomel which has been recently sublimed and recondensed, the irritation from the fumes is usually very slight. This treatment does good not only by its local effect in the larynx, but by keeping the bronchi protected, and thus preventing the most common and fatal complication of laryngeal diphtheria—the extension of the disease to the bronchi. This treatment, which was first suggested by Corbin of Brooklyn, is not only of great value after operative interference, by preventing the extension of the disease to the bronchi, but its early use will in many cases obviate the necessity of an intubation or a tracheotomy. Besides this, it keeps the sick-room disinfected and helps to prevent the spread of the disease. The attendant should be cautioned to inhale the vapor as little as possible, as it is surprising how frequently the nurse becomes salivated and how seldom the patient is at all affected. However, this treatment seems to have a depressing effect on some patients, although there are seldom any other evidences of mercurialization; but it should be remembered that in infants and young children mercury is not liable to produce salivation

as in adults. Its effects are shown rather by marked anæmia and depression, with signs of irritation of the intestines and the kidneys.

The operative treatment of diphtheria will be considered elsewhere, but the following suggestion may be of value in overcoming one of the most serious complications that arises—namely, loose membrane in the trachea or bronchi. Its removal by aspiration, by tubes of large calibre, and by numerous kinds of forceps has been attempted, but with little or no satisfaction. The most successful method in my own practice is to insert a small laryngeal applicator, the cotton on which is covered with a very sticky substance like Canada balsam. Upon its withdrawal more or less of the membrane remains adherent to it, and after several trials and in many cases the loose membrane is all brought out.

Recent studies in immunity offer the most brilliant prospects for advancement in the treatment of diphtheria, as well as all the infectious diseases; and it would seem as if bacteriology was about to revolutionize medicine by giving us a specific treatment for these diseases. The study of the toxines and toxalbumins of infectious diseases has led to the discovery of antitoxines in the blood of animals immune against diphtheria. In other words, it was found that the blood or serum of animals immune against diphtheria, if injected into susceptible animals, prevents the infection with cultures of the Klebs-Loeffler bacillus. Again, an injection of this antitoxine after the animal is already infected will neutralize or destroy the poison produced by the bacilli. The practical point remains to isolate these antitoxines, and test their specific action in neutralizing the poisonous products of the bacillus. This has been done, and the success in treating animals has been so great that trials in human patients will be made with the prospects of most brilliant results.

Treatment of Sequelæ.—The treatment of the sequelæ and the albuminuria of diphtheria requires a few words. The albuminuria of this disease seems to be very little affected by treatment. The best that can be done is to put the patient on a proper diet, compel the skin and the intestinal tract to do the work of the kidneys as much as possible, and to give a diuretic mixture—*e. g.* the infusion of digitalis with acetate of potassium. In bad septic cases the tincture of the chloride of iron seems to be useful; but marked diminution of urine, especially anuria, with a large amount of albumin, seems to be unaffected by any treatment, and usually ends fatally.

The anæmia should be treated by improving the nutrition and general condition in every possible way, and giving an iron mixture internally, a most satisfactory one being—

℞. Tr. ferri chloridi . . . . . f℥iij to xij.
Glycerini . . . . . f℥j.
Aquæ . . . . . ad f℥iv.—M.
Sig.—Teaspoonful three times daily, in water, through a glass tube.

The chronic catarrh left after the disappearance of the pseudo-membrane should receive prompt and efficient treatment. In most cases the local application, continued for some time, of a weak solution of nitrate of silver will be all that is needed. But there are cases which may require operative interference and special treatment; and this treatment is discussed at another place in this work.

The natural tendency of the post-diphtheritic paralysis is to recovery. This is aided by every means which tends to increase the nutrition and improve the general condition. Therefore, good hygienic surroundings, plenty of easily-digested and nourishing food, iron, quinine, strychnine, and other tonics, are

indicated. Strychnine, either hypodermatically or by mouth, seems to affect most beneficially the paralyzed muscles, one-sixtieth to one-thirtieth of a grain being given in twenty-four hours. Besides this, the careful use of massage and electricity does good service in assisting the nutrition and circulation of the affected muscles until the nerve-lesion gets well.

Synopsis of Treatment.—In brief, the treatment of diphtheria may be summarized as follows:

1. Put the patient in the best hygienic surroundings, with plenty of fresh air and sunlight. Keep the room at a uniform temperature of about 70° F., and give him an abundance of clean linen and bed-clothes. In protracted cases transfer the patient to a fresh room that has been thoroughly aired and not exposed to the disease, as many cases are undoubtedly liable to reinfection.

2. Keep up the strength and nutrition of the patient with plenty of stimulants and easily-digested and nourishing food.

3. Avoid all internal medication unless clearly indicated. The bichloride of mercury is useful, and in certain septic cases the tincture of the chloride of iron. The chlorate of potassium is dangerous.

4. Remove all broken-down membrane, pus, and other débris by irrigation of the diseased surface with a fifteen-volume solution of peroxide of hydrogen, diluted with lime-water.

5. To destroy the bacilli after the surface has been cleaned apply a solution of bichloride of mercury, 1:1000, either by irrigation or spray, and keep the room saturated with the vapor from a mixture of carbolic acid, turpentine, and eucalyptus. When it is impracticable to use the spray or irrigation, either from the location of the disease or the impossibility of managing the child, the best substitute is to make the patient inhale the fumes obtained by subliming calomel.

6. The treatment of the albuminuria is very unsatisfactory; in septic cases the tincture of the chloride of iron, in addition to the digitalis and acetate of potassium, gives the best results.

7. The sequelæ should be treated according to indications—the anæmia with iron and general tonics; the chronic catarrh by the application of weak solutions of nitrate of silver; and the paralysis by strychnine, massage, electricity, and general tonics.

8. Recent studies in immunity have given us a knowledge of an antitoxine which neutralizes and destroys the toxalbumin of the diphtheria bacillus, and, although its use has been confined, so far, to experiments upon animals, the results in these cases have been successful enough to justify its use in the human organism.

TRACHEOTOMY.

By HENRY R. WHARTON, M. D.,

Philadelphia.

The operation of tracheotomy consists in opening the trachea by an incision through the tissues in the anterior region of the neck, as nearly as possible in the middle line, and is a surgical procedure which is adapted for the relief of dyspnœa due to laryngeal or tracheal obstruction. The operation may be required to relieve the dyspnœa dependent upon membranous or diphtheritic laryngitis, or œdema of the mucous membrane of the larynx or trachea from inflammation due to burns or scalds, or to the inhalation of irritating gases, or the swallowing of corrosive liquids. The operation may be indicated to relieve dyspnœa arising from growths in the larynx or trachea; from growths external to these organs, but causing pressure upon them; and it may also be required for the removal of foreign bodies from the larynx or trachea, as well as for the relief of dyspnœa due to their presence. Tracheotomy may also be called for in cases of fracture or laceration of the larynx or in cases of spasm of the glottis. The indication for operation in all of these cases is a form of obstructive dyspnœa which threatens life.

The most reliable symptoms of tracheal or laryngeal obstruction are recession of the anterior and lower portion of the chest-walls, forcible retraction of the tissues of the epigastrium and of the suprasternal notch, and of the supraclavicular and intercostal spaces during inspiration. Where these symptoms are marked there exists some serious mechanical obstruction to the entrance of air into the lungs. A child suffering from well-marked obstructive dyspnœa has more or less suppression of the voice, and presents lividity of the lips, blueness of the finger-tips, and, as the dyspnœa increases, becomes restless and cannot breathe in a recumbent posture, is unable to sleep, sits up in bed, clutches at his throat as if to remove the offending substance, and presents a picture of distress which, when it has once been observed, cannot well be forgotten. By the change of position the auxiliary muscles of respiration are brought into play; and the restlessness and inability to sleep, except at short intervals, are explained by the well-known fact that in normal sleep the action of the diaphragm is diminished, but, when obstructive dyspnœa is present, its action is exaggerated, so that sleep is impossible. A mistake should not be made in confounding labored breathing, which is always present in cases in which there exists mechanical obstruction to the entrance of air into the lungs, with frequent breathing, which depends upon diminished air-capacity of the lungs. I call special attention to this symptom—labored breathing—as I am frequently called to see cases to perform tracheotomy where the mistake is made in confounding these two forms of dyspnœa.

The operation of tracheotomy is considered by some surgeons a minor, by others a major operation; but my own experience leads me to consider it a delicate and anxious one, for the condition calling for its performance is one

which involves a vital function; and, although the operator may often be surprised at the facility with which the trachea is exposed and opened, yet in other cases presenting apparently similar conditions he may at each step be met with difficulties which render it a most formidable surgical procedure. I think Mr. Marsh places the operation in its proper position when he says that tracheotomy should be regarded as a delicate operation which requires coolness and caution in its performance, rather than one which is very difficult or dangerous. I am decidedly of the opinion that in this operation coolness in the operator is a matter of the first importance, and that, in spite of the alarming symptoms that may be presented, the judicious surgeon will not allow himself to be unduly hurried in its performance, bearing in mind the fact that in cases of obstructive dyspnœa, except in certain very rare instances, death comes on slowly, that there is generally more time than at first appears, and that precipitated action at the beginning of the operation may cause much time to be lost before its completion. Tracheotomy is most frequently called for in young children, and in this class of patients certain anatomical conditions are present, such as shortness of the neck, abundance of adipose tissue, great vascularity of the parts, a relatively larger size of the isthmus of the thyroid gland, and the possible presence of the thymus gland; all these conditions render the trachea difficult to expose and open.

The time at which tracheotomy should be performed in cases of obstructive dyspnœa is a point upon which there exists some diversity of opinion. Some operators insist that it should be undertaken as soon as the dyspnœa is well marked, while others postpone surgical interference until the symptoms have become so urgent as speedily to threaten life. I am of the opinion that the operation should not be performed until the dyspnœa is marked and increasing, unless it be due to the presence of a foreign body or a growth in the air-passages, or to an injury of the larynx or trachea, under which circumstances there is no reason to delay. In cases of dyspnœa due to membranous laryngitis or inflammatory conditions of the larynx or trachea, I think the surgeon should be largely guided as to the proper time for interference by the urgency of the dyspnœa and the constitutional condition of the patient. When a patient presents the marked symptoms of dyspnœa which have been previously pointed out, and in addition exhibits extreme restlessness and inability to sleep, I think nothing is to be gained by delaying the procedure, for I have never seen such cases recover without operative interference. If, however, he can sleep for a few minutes at short intervals, although the symptoms of obstruction are present—I am in favor of postponing the operation, since under such circumstances I have seen very urgent cases recover without tracheotomy.

Another question on which the surgeon is consulted is the advisability of performing tracheotomy in very advanced cases. Here, if an examination of the patient shows that he is not dying of cardiac failure and auscultation of the chest reveals the fact that air is entering the lungs, even though there may be evidence of extension of the membrane into the bronchial tubes, I consider that the urgency of the symptoms presented certainly demands the performance of the operation; for in a number of these most unpromising cases, where the patients have been apparently moribund at the time of operation, I have seen recovery follow. The operation usually prolongs life even if it does not save it, and generally prevents the patient from dying by a most distressing form of death—strangulation—for in my experience death from recurrent obstruction after tracheotomy is comparatively rare, the majority of cases perishing from pneumonia, from heart failure, or from general adynamia. Many cases

of croup are unquestionably allowed to die without operation where, possibly, tracheotomy might have averted the fatal issue; for there is, unfortunately, among the people a tendency to attribute death, if it results after the operation, to the surgical procedure itself, and not to the disease which necessitated its performance. It is often difficult for this reason to obtain the consent of parents to have the operation performed upon their children, but this opposition may generally be overcome by a candid statement as to what may be accomplished by the procedure. I think there is also among the profession too much tendency to look upon tracheotomy as a last resort, and after it has been performed to relax the local and constitutional treatment of the case; but this is manifestly unwise, for the operation simply fulfils one of the indications in the treatment—viz. to remedy the imperfect air-supply; and it does not supplant previous appropriate constitutional or local measures. It may be laid down as a safe rule of practice that tracheotomy is indicated in all cases of persistent and increasing dyspnœa due to mechanical obstruction of the larynx or adjacent parts of the trachea.

Anatomy of the Anterior Region of the Neck.

In the operation of tracheotomy it is essential that the operator should bear in mind the anatomical structure of the anterior region of the neck. In cutting down upon the trachea in the middle line of the neck from the cricoid cartilage to the sternum, as soon as the skin has been divided the *superficial fascia* is exposed, and beneath this is the *deep cervical fascia*, which encloses the sterno-hyoid and sterno-thyroid muscles. The veins of the neck are most important in their relation to tracheotomy, because they are often irregular in distribution, and from the fact that in all forms of pulmonary obstruction they become greatly distended, and injuries to them may be followed by very profuse hæmorrhage. Upon opening the superficial fascia a large superficial venous branch, the *superficial anterior jugular vein*, may be met with, or there may be two veins running parallel with the trachea on each side of the median line, which communicate by a large transverse branch at the lower part of the neck; they are usually placed one on each side of the median line; one may be larger than the other, or one may cross the median line and empty into its fellow. A large plexus of veins also surrounds the thyroid isthmus, opening above into the superior thyroid and below into the inferior thyroid vein. The innominate vein on the left side occasionally rises above the level of the sternum, and has been exposed and injured during the operation of tracheotomy. The *sterno-hyoid* and *sterno-thyroid muscles* are most important landmarks in this operation. At their upper attachment they are not quite in contact, and as they descend the neck they are further separated; the space between them, which occupies the median line of the neck, is a most important guide to the operator.

The arteries of the neck which are of most importance in the operation are the *crico-thyroid artery*, a branch of the superior thyroid, and the *thyroidea ima*, an irregular branch from the aortic arch or from the innominate. In children the innominate artery occasionally rises into the pretracheal space, and this vessel was once exposed by Lücke below the isthmus of the thyroid in performing tracheotomy. The *isthmus* of the *thyroid gland* is a very important structure in the operation of tracheotomy, and varies much in size in different individuals. It is generally largely developed in children, often covering the second or third rings of the trachea, and in some cases extending higher and covering the cricoid cartilage. *The thymus gland*, in children under two years

of age, may be exposed in opening the trachea below the isthmus of the thyroid gland; I have myself seen it present in a number of cases in young children. The *trachea* begins at the lower border of the cricoid cartilage and terminates opposite the fourth dorsal vertebra, although its surgical limit is the upper border of the sternum. It is most superficial near the cricoid cartilage, is surrounded by loose cellular tissue or the tracheal fascia, and is more movable in children than in adults. Its size varies in different individuals of the same age, being larger in male than in female children. The diameter of the trachea under eighteen months of age is about 4 mm.; from two to four years, 6 mm.; from eight to twelve years, 10 mm.

Tracheotomy in Diphtheritic or Membranous Laryngitis.

In children suffering from membranous or diphtheritic laryngitis obstructive dyspnœa is most common; and it is in this class of cases that the surgeon is most frequently called upon to perform tracheotomy.

Indications for Operation.—In diphtheritic or membranous laryngitis the symptom calling for operative interference is a form of obstructive dyspnœa characterized by suppression of the voice, great difficulty in inspiration, lividity of the lips, depression of the suprasternal and supraclavicular spaces, sinking of the lower part of the chest, inability to breathe in the recumbent posture, great restlessness, and inability to sleep. These symptoms being present and increasing, I think that the operation of tracheotomy is urgently indicated.

Prognosis of Tracheotomy in Diphtheritic or Membranous Laryngitis.—It is to be expected that the prognosis under the above conditions is more unfavorable than in cases where the operation is undertaken for the relief of dyspnœa due to simple inflammatory affections of the larynx or to the presence of foreign bodies in the air-passages. This is not remarkable when we consider the fact that, in addition to the local condition of the larynx or trachea which necessitates the surgical interference, there exists a most grave constitutional disease which is very fatal in childhood, even in cases where no symptoms of obstructive dyspnœa are developed. An examination of large collections of recorded cases best shows the results following tracheotomy in this class of cases. Cohen, in the study of 5000 tracheotomies for croup and diphtheria, found that about 1 case in 4 recovered after the operation. Krönlein reports 504 similar cases, with 29.2 per cent. of recoveries. Chaym, in 1000 tracheotomies, gives the proportion of recoveries as about 1 in 4. Mastin, in a collection of 863 tracheotomies for diphtheritic croup in the United States, shows that the recoveries were about 26 per cent. At the Children's Hospital of Philadelphia the percentage of recoveries in all cases of croup operated upon to the present time has been about 43 per cent. Lovett and Munroe, in a collection of 21,853 tracheotomies for diphtheria and croup, drawn from all sources, show that there were 6135 recoveries and 15,552 deaths, or about 28 per cent. of recoveries. The statistics of individual operators are often more favorable in a limited number of cases, some being able to show more than 50 per cent. of recoveries; but such statistics are manifestly unreliable, as additional cases would probably very markedly diminish the proportion of successes. In a series of 5 tracheotomies for diphtheritic laryngitis I have had 4 recoveries, while in 6 operations preceding this series the result was uniformly fatal. In 15 tracheotomies recently performed at the Children's Hospital there were 8 recoveries—a result which even the most enthusiastic advocate of the operation could not hope to sustain with additional cases. In recent years it

seems the results of tracheotomy for diphtheritic laryngitis have been more favorable, depending possibly upon better judgment as to the time of the operation and the greater care which is exercised in the details of after-treatment, as well as upon the improved constitutional treatment of the disease. By comparison of a large number of operations for diphtheritic or membranous laryngitis, it will be seen that the proportion of recoveries is very similar; that is, about 1 recovery in every 4 cases.

Age in the Prognosis.—The age of the patient is a very important factor in the prognosis. In infants and very young children recoveries are not very numerous after the operation, yet there have been enough successful cases to show that age alone is not a contra-indication to tracheotomy in this class of patients. A successful case is reported by Scoutetten in an infant of six weeks, one at two months by Steinmeyer, at three months by Annandale, at five months by Croft, at six months by Kisler; and from this age to two years a number of successful results have been reported. Krönlein, in 85 cases of tracheotomy in children under two years of age, reports 11 recoveries. Chaym, in 997 cases in children two years of age and under, found that only 15.5 per cent. recovered. Archambault, of the Children's Hospital of Paris, presents some statistics bearing upon the results of this operation at different ages:

Of	976	cases	in	children	from	1	to	3	years	of	age,	104 recovered.
"	822	"	"	"	"	3	"	4	"	"	"	175 "
"	736	"	"	"	"	4	"	5	"	"	"	174 "
"	497	"	"	"	"	5	"	6	"	"	"	148 "
"	547	"	"	"	over 6 years of age,							198 "

It will be seen from these facts that very early age affects the prognosis unfavorably, but it also must be borne in mind that the disease for which the operation is performed is itself more fatal in infants and young children.

Instruments Required for Tracheotomy.—In an emergency tracheotomy may be performed with very few implements, but if the surgeon has the choice he will find it convenient to have the following instruments at hand:

2 Small scalpels,
1 Short grooved director,
1 Tenaculum,
3 Aneurism needles, which may be used as retractors,
1 Pair of artery forceps,
4 Hæmostatic forceps,
2 Pairs of dissecting forceps,
1 Sharp-pointed tenotome,
1 Pair of tracheal forceps,
Tracheal dilator,
Tracheotomy-tubes and tapes,
Flexible catheter,
Ligatures,
Needles,
Feathers,
Sponges,
Sutures.

The scalpel should be small and narrow in the blade, so that it shall obscure as little as possible the operator's view of the wound. The grooved director should be shorter and slightly broader than the one generally used (Fig. 1), and it should have a bevelled extremity, which allows it to pass with ease through the different layers of tissue. The ordinary director is usually too long to use with satisfaction in the short necks of children.

Hæmostatic forceps are most useful to temporarily secure vessels which bleed profusely; they may also be useful in clamping the isthmus of the thyroid gland on either side, where it is to be divided to expose the trachea under similar circumstances.

Tracheal forceps may also be of great use after the trachea has been opened or the tube has been introduced, (Fig. 2), to remove loose shreds of membrane.

A sharp-pointed tenotome is the knife I prefer in opening the trachea; its sharp point enables it to be thrust easily into the trachea, and its short cutting surface and narrowness of blade are additional advantages, as they enable the operator to see exactly where he is cutting. Of tracheal dilators, either Golding-Bird's (Fig. 3) or Trousseau's (Fig. 4) are the best forms. They can be slipped into the tracheal wound, and thus its edges can be held apart until the trachea is cleared of membrane before the tube is introduced. Golding-Bird's dilator, which is a self-retaining one, is, I think, a very valuable instrument. Tracheal dilators may be improvised from bent hair-pins or pieces of wire, which may serve the purpose when ordinary dilators cannot be obtained. Silk or silver sutures may also be passed through the edges of the tracheal wound and used as dilators. Soft or pliable feathers may be introduced into the trachea or larynx to remove mucus or membrane with little risk or injury to the parts. The best feathers for this purpose I have found to be the tail feathers of the turkey.

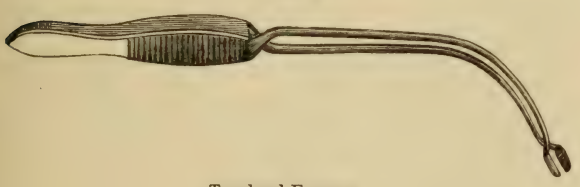
Fig. 1.



Author's Tracheotomy Director.

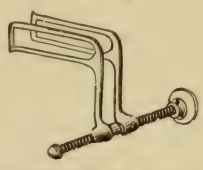
Tracheotomy-tubes.—Tubes of various sizes should be at hand; and it is well to remember that the best tracheotomy-tube is one which fits the trachea neatly and inflicts the least possible injury upon it. To ensure this, the part of the tube within the trachea should lie exactly in the axis of the trachea, and its free extremity should be capable of as little movement as possible. The instrument now in general use is a quarter-circle tube, which is made of silver and consists of two tubes—an outer one which is attached to a movable collar which fits to a shield, to which tapes are fastened to secure it in position, and a movable inner tube which closely fits the outer tube. The mov-

Fig. 2.



Tracheal Forceps.

Fig. 3.

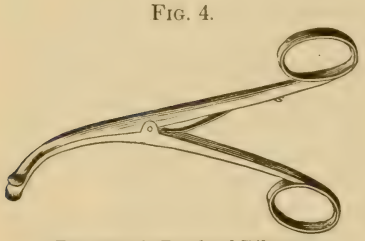


Golding-Bird's Tracheal Dilator.

able collar, which allows the tracheal portion of the tube to change its position during the movements of the trachea and neck, was suggested by M. Roger, and is a modification which has ensured both comfort and safety in the wearing of this instrument. I usually employ a tracheotomy-tube which is of the same calibre throughout, and does not taper toward the lower extremity, as is the case with many of those sold in the shops. I also prefer the non-fenestrated tube; the ordinary instrument usually has a fenestra in the outer tube, but I have never been able to see any advantage in this, as it is generally placed at such a position that it is not continuous with the tracheal canal when the tube is in position; and I think its presence is even a decided disadvantage, as it may be difficult to introduce the inner tube by the bulging of the tissues into it. The tube which I have found most satisfactory is the quarter-circle tracheotomy-tube made of silver, as above described, and provided with a fenestrated guide, which materially facilitates its introduction (Fig. 5).

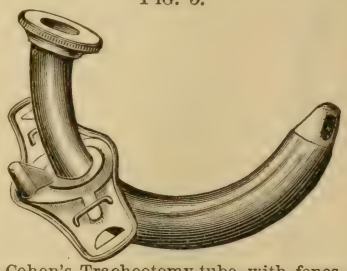
To diminish the risk of erosion of the trachea or mucous membrane many other forms of tracheal tube have been devised, notably those of Durham,

FIG. 4.



Trousseau's Tracheal Dilator.

FIG. 5.



Cohen's Tracheotomy-tube, with fenestrated guide.

Parker, Morant, and Baker. The latter has devised and used flexible tubes made of vulcanized red rubber. Professor Little recommends a non-fenestrated tube constructed of aluminium, which has the advantage of great lightness. Tracheotomy-tubes constructed of hard rubber have also been recommended by some surgeons, but in my experience they are too bulky and are not adapted for use in recent cases, though they may be employed with advantage in cases where the tube has to be worn for a long time.

The size of the tracheotomy-tube to be employed in an individual case is a matter of some importance, as the calibre of the trachea varies with the age and sex of the patient, being smaller in female children than in males of the same age. The safest rule of practice is to introduce a tube which fits the trachea comfortably. I usually find that a No. 2 tracheotomy-tube fulfils this condition in children under two years of age; in those from two to four years of age a No. 3 or 4 will usually be found satisfactory. The fear of injury to the trachea by the continued presence of a tube has caused some surgeons to substitute for it a tracheal dilator made of wire; such devices have been suggested by Watson, Bigelow, and Packard. The latter surgeon has constructed such a dilator which is self-retaining and has somewhat the mechanism of the eye-speculum. Experience with the use of these substitutes has been very limited, and I am inclined to think they will prove only of value for temporary use.

Choice of Operation.—There are two points at which the trachea may be opened, constituting respectively the *high* and *low* operations. In the high operation the trachea is opened above the isthmus of the thyroid gland, and in the low operation the opening is made below this structure. The high operation is generally selected in children, because at this point the trachea is most superficial, and for this reason is more readily exposed and opened. In the high operation the cricoid cartilage is frequently divided with the upper rings of the trachea. The low operation cannot be executed so rapidly, and is certainly much more difficult in its performance, because of the relatively greater depth of the trachea, the large size and number of veins exposed, and the proximity to the large arterial trunks. In young children the extreme shortness of the neck sometimes prevents the satisfactory adjustment of the tracheotomy-tube when the low operation is performed. I call to mind the case of a young child in whom I did a low operation, where the lower extremity of the tube came in contact with the bifurcation of the trachea, and it was only after I had the tube shortened that the child could wear it with comfort. Many operators prefer the low operation: Cohen expresses himself decidedly in its

PLATE XI.



POSITION OF PATIENT FOR TRACHEOTOMY.

favor in case the tube is to be worn for a long time or where the operation is done for a foreign body impacted in the bronchus. I am myself decidedly in favor of the high operation in cases of diphtheritic or membranous laryngitis when the tube is to be worn only for a short time, and I would therefore recommend those who have had little experience with the procedure to employ the high operation, on account of the greater ease and safety of its performance, save in the exceptional conditions referred to by Cohen.

Position of the Patient for Tracheotomy.—In the operation of tracheotomy it is a matter of the first importance that the patient be placed in such a position that the neck shall be brought into the greatest prominence, to render the trachea more superficial and give the greatest amount of space between the sternum and the chin; and it is surprising with how much more ease the operation will be accomplished if the patient be placed in this position. The most satisfactory exposure of the neck may generally be obtained by laying the child upon his back upon a firm table and placing beneath the shoulders a small round cushion or an empty wine-bottle or an ordinary wooden roller-pin wrapped in several towels (Plate XI). In this position the head is allowed to drop down, coming in contact with the table; the trachea is pushed upward, and becomes more prominent, and the anterior portion of the neck is more accessible to the surgeon. The nurse or an assistant should secure the head by applying the hands to its lateral aspects, thus preventing the child from moving it during the operation, and an assistant should also control the movements of the body and arms of the child by holding them firmly against the table. This is much better than securing the arms by pinning a binder around the chest, and does not restrict the already embarrassed respiratory movements. The same result may be obtained by dropping the child's head over the edge of the table and having it held in this position.

Use of Anæsthetics in Tracheotomy.—As to the use of anæsthetics in the operation there is much difference of opinion among surgeons: many operators of large experience express themselves as decidedly opposed to the use of an anæsthetic on the ground that it is unnecessary and its employment increases the danger of the operation. On the other hand, many surgeons of equally large experience commend anæsthesia, not only as facilitating the operation, but also as not interfering with the success of the procedure. My own experience leads me to agree with the former class of surgeons, and I think there is a growing tendency to discard the use of anæsthetics in this operation. In operating in cases of diphtheritic or membranous laryngitis, I never use an anæsthetic. I have seen cases, which were breathing fairly well before its administration, after its use suddenly become so much obstructed that the operation had to be much hurried, and the trachea opened rapidly even before it was thoroughly exposed—a procedure which is always attended with danger. The unfortunate cases in which I have seen death occur during the operation have generally been those in which an anæsthetic had been used, and in which the above-named complication occurred, necessitating the hurried opening of the trachea, often followed by profuse hæmorrhage. Tracheotomy itself is not painful when the dyspnœa is well marked, and after the incision in the skin is made little pain is experienced in the subsequent steps of the operation. In this connection I mention the observation made by Brown-Séquard that an incision of the tissues of the anterior region of the neck causes anæsthesia of the surrounding parts, and hence it is only the first incision which gives rise to pain in tracheotomy. Mr. Hewitt in a recent paper very well explains the danger in the use of an anæsthetic in cases of obstructive dyspnœa. He says that

"in such cases cyanosis is kept at bay, not only by compensatory increase in the activity of the nerve-centres which preside over normal respiratory movements, but also by the co-operation of the centres which preside over muscles which take little or no share in ordinary breathing. During ordinary sleep the activity of the diaphragm is lessened, the centres which preside over it enjoying comparative rest; while in obstructed dyspnœa the patient to a greater extent depends upon the increased action of the diaphragm, so that natural sleep is generally impossible except at short intervals. These vicarious centres will certainly fall victims to the anæsthetic sooner than the automatic or superior centres. The anæsthetic will not therefore respect vicarious function, and the muscles will become paralyzed in the usual sequence, and the patients will become more embarrassed in their breathing or the breathing will cease altogether."

If an anæsthetic be used, chloroform is probably preferable to ether, as it is not so apt to cause vomiting, and it may be used with safety in operating at night, when close approximation of a light may become necessary.

The Operation of Tracheotomy.—The child being placed in the position described, the head steadied, and the movements of the body controlled by assistants, the operator should take his position either on the right side of the patient, or, as I prefer, at the head of the patient, for in this position it is easy to keep the incision exactly in the median line of the neck. The surgeon then should make himself familiar with the landmarks of the neck; and having located the position of the cricoid cartilage with the finger, he makes an incision in the median line two or two and a half inches in length, the position of the cricoid cartilage being the middle point. There is no disadvantage in a long incision, which gives the operator a good view of the tissues through which he is to pass; there are many disadvantages in a too short incision.

The first incision should divide the skin and expose the superficial fascia; upon exposing this the operator will occasionally see parallel with or directly under the line of incision a large vein lying in the superficial fascia, the superficial anterior jugular vein. This should be displaced, and next the fascia should be picked up with forceps, nicked with the point of a knife, raised upon a director, and divided freely. In the early steps of the operation the surgeon should take care to see that the wound is kept directly in the median line of the neck, for this is the line of safety, and he should be careful also, as the wound increases in depth, not to make the incisions so short that it becomes funnel-shaped, so that a sufficient space of the trachea cannot be exposed to view. When the deep fascia is reached, it should be picked up and divided upon a director, and any large veins in the line of the wound should be carefully displaced, or, if this be impossible, should be clamped by hæmostatic forceps or ligatured on each side and then divided between the forceps or ligatures. The operator should next search, having the wound well sponged, for the muscular space between the sterno-hyoid and sterno-thyroid muscles: this can generally be found without difficulty, and the muscles should then be separated with a director or the handle of a knife, and the isthmus of the thyroid gland will be exposed. The muscles should then be held aside with retractors placed one on each side, the aneurism needles previously mentioned serving well for this purpose.

In regard to the use of retractors at this point, a caution is not out of place: the operator should place them himself and allow the assistant to hold them. I once almost lost a case in which, after exposure of the trachea, while I had turned aside to pick up a knife, my assistant replaced one retractor which had slipped; in doing so the movable trachea was caught in the grasp

of the retractor and drawn to one side, completely shutting off respiration. When I attempted to find the trachea to open it, I could simply feel the anterior surface of the vertebræ at the bottom of the wound, and it was only when I lifted the retractor and allowed the trachea to spring back to its normal position that I was able to open it. Other operators have had the same experience. Mr. Durham mentions a case, and Mr. Howard Marsh also one, in which the trachea and great vessels were held aside by an assistant until the surgeon had exposed the cervical vertebræ. It is well for the operator to constantly explore the wound with his finger, to locate exactly the position of the trachea, and to ascertain the presence of any anomalous arterial branch.

The isthmus of the thyroid gland being exposed, it is generally found surrounded by a venous plexus, and occupies a position over the first three tracheal rings, or it may extend even higher and cover the cricoid cartilage. At this point of the operation the surgeon may find that the isthmus of the thyroid gland, if large, bulges up and fills the whole wound, and he should endeavor to displace it either upward or downward: this it is often possible to do without difficulty. But should it be found firmly fixed, and the trachea cannot be exposed either above or below it, it may be cut through after being ligatured or clamped on each side to prevent hæmorrhage. A procedure recommended by Bose, which I have employed with advantage in several cases, may also be made use of—namely, a transverse incision is made across the cricoid cartilage to divide the layer of cervical fascia by which the isthmus is bound down, and a director is then passed in, and the isthmus is displaced downward without difficulty. After displacing the isthmus of the thyroid gland upward or downward, as the case may be, the trachea, yellowish-white in appearance, covered by its fascia, should be exposed. This fascia should be torn through with a director or the handle of a knife, so as to bare the surface of the trachea. On this point all authorities agree—namely, the importance of thoroughly clearing the trachea of its fascia before opening it, as by so doing it is easier to incise it and to introduce the tracheotomy-tube. In breaking up this fascia the operator can feel it crepitate under the finger from the suction of air drawn in with each inspiratory movement.

When the surgeon has the trachea exposed, he may then take time to see that the wound is free from hæmorrhage, and may replace the retractors so as to expose as large a portion of the trachea as possible; for, be the case ever so urgent, he now feels assured that he can open the trachea in a moment if the breathing should cease. The trachea should next be fixed with the point of a tenaculum introduced a little to one side of the median line; and an incision made in the median line from below upward for a distance of half to three-fourths of an inch. Some surgeons object to the use of a tenaculum to fix the trachea, as it arrests respiratory movements, but prefer to use the tip of the finger as a guide to steady the trachea before it is incised. I always use the tenaculum in this way, and see no disadvantage in its use if the trachea is not fixed for too long a time before the opening is made. The operator may find it of advantage, especially in cases where the trachea is deeply situated, after fixing it with a tenaculum, to lift it slightly from its bed, thereby bringing it more prominently into view and making it more superficial in the wound, thus facilitating its safe incision.

I prefer in opening the trachea to employ a sharp-pointed tenotomy knife: the sharp point allows it easily to be thrust into the trachea, and the narrow blade obscures the operator's view of the wound to the least possible extent. The knife should not be introduced so deeply into the trachea that the posterior wall or the œsophagus may be injured: both of these accidents have occurred by

a too deep thrust of the blade. The operator should also be careful not to make a too superficial incision, which might divide only the trachea and the mucous membrane, while the false membrane, if it be present, is not divided; and the cavity of the trachea therefore not opened: under such circumstances, if the tracheotomy-tube is hurriedly introduced, it may pass between the trachea-wall and the false membrane, and no relief from the dyspnœa will be obtained. I have seen this accident occur and death result from it. I have already spoken of the importance of keeping in the median line in exposing the trachea, and I think it of equal importance to have the incision into the trachea itself in the median line, for these wounds are said to heal more promptly; and, if the wound be made to either side of the median line of the trachea, the tube does not fit well, and its lower extremity may cause damage to the lateral aspect of the trachea. It is often a matter of great difficulty to introduce the tracheotomy-tube in a case where the tracheal incision is far out of the median line; and if this is found to be the case, I think it is wiser to make a second incision in the median line, disregarding the previous one, which generally heals without difficulty.

As soon as the trachea is opened there is usually thrown from the wound, with the first expiratory effort, mucus or false membrane; this should be wiped away with a sponge, and the tracheal dilator introduced. It is well to remember that the tenaculum should not be removed until the tracheal dilator or tracheotomy-tube is placed in position, as it is often difficult to introduce either of them into the movable trachea after the tenaculum has been removed. It is not unusual, after the trachea has been opened, to have a sudden arrest of respiration; the entrance of a large body of air, according to Cohen, seems, as it were, to surprise the lungs. This is apt to produce great alarm to one not familiar with the circumstance, as it looks like a cessation of breathing; it is especially trying to the operator when he is about to congratulate himself upon the completion of an anxious operation. This arrest of respiration is usually only momentary, and if the child's face and chest be slapped with a wet towel, or artificial respiration be employed, normal respiratory movements will soon be re-established.

The trachea being opened and the tracheal dilator being introduced, any membrane which appears at the wound should be removed with a sponge or forceps, and the trachea should be explored both above and below the wound for the presence of false membrane, which should be removed with forceps, a feather, or a camel's-hair brush. This removal of membrane from the trachea has been urgently insisted upon by Pilcher, Parker, and others; and I think that it is largely owing to the great care which is exercised in this particular that the results of tracheotomy in diphtheritic cases in the last few years has been so much more encouraging.

Mouth-suction of the wound, which has been frequently employed by surgeons to restore respiratory movements and clear the trachea of membrane, has been so often followed by disastrous results that it cannot be too strongly condemned. This procedure is no more efficient in removing membrane or re-establishing respiration than the use of the forceps, brush, or feather, or the employment of artificial respiration made in the ordinary manner. For the purpose of clearing the trachea Parker has devised a tracheal aspirator, which consists of a glass or celluloid cylinder three or four inches in length by three-quarters of an inch in diameter, to the one extremity of which is attached a flexible tube and to the other an India-rubber tube with a mouth piece at the end. The cylinder may be packed with antiseptic cotton, which will act as a filter and prevent any infected material from reaching the operator's mouth. A

flexible catheter may be employed for the same purpose with good results. The membrane is usually loosely attached, and can be removed with forceps or a flexible feather, particularly if a little of Parker's soda solution be brought in contact with the inner surface of the trachea. The peroxide of hydrogen may also be employed with satisfaction for the same purpose.

After removing the membrane, Mr. Watson Cheyne recommends that the raw surface be touched with a solution of bichloride of mercury 1 : 500; he also introduces into the trachea or larynx above the tube strips of lint saturated with a solution of bichloride of mercury 1 : 2000, and washes the wound with a similar solution of 1 : 500.

Having cleared the trachea of membrane, the tracheotomy-tube should be introduced. This can be accomplished without difficulty if a fenestrated guide be employed, and if the wound in the trachea has been made in the median line; the tube is secured in position by the tapes attached to the shield, which are tied around the neck. The tapes should be firmly tied by several knots, so that there may be no possibility of the child untying them when not watched by the attendant, as in such an event the tube may become displaced when there is no one at hand competent to replace it. These knots should be tied on either one or other side of the neck, and not posteriorly, where their presence would cause the child discomfort as he rests upon his back.

The immediate results of the operation are, as a rule, most encouraging: the patient, who previously exhibited the most distressing symptoms by reason of his extreme dyspnœa, now becomes quiet; the color improves, the respiration becomes natural, and it is not an unusual occurrence to have him fall into a quiet sleep before he is removed from the operating table to his bed.

Complications at the Time of Operation.—The principal complication at the time of operation is hæmorrhage, which may be either arterial or venous. Hæmorrhage should be prevented by great care in avoiding the wounding of any vessels of considerable size: if their injury is unavoidable, they should be immediately ligatured, or, if the case is too urgent to admit of delay, they should be secured by hæmostatic forceps, and after the trachea has been opened they can be permanently secured by ligatures.

Sudden Arrest of Respiration.—Cessation of the respiratory act during the operation is a most dangerous symptom, and one which calls for prompt action on the part of the operator. The surgeon's duty under the circumstance is to open the trachea as rapidly as possible—even through a pool of blood, as described by Mr. Durham—introduce the tracheal dilator, and make artificial respiration: by such prompt action many cases may be saved, and bleeding vessels may be ligatured or secured by forceps after the trachea is opened. Mr. Durham very wisely says that in those reported cases in which much blood is lost during the operation, and which are abandoned before opening the trachea because of the cessation of respiration, death is not the result of hæmorrhage, but of failure to complete the operation. Blood in the trachea after the operation may seriously embarrass the breathing, but if the tracheal dilator is introduced, it may be removed by the use of a brush or feather.

After-Treatment of Cases of Tracheotomy.—The operation of tracheotomy relieves the patient of the immediate danger of death by strangulation, yet there still exist the same indications for local and constitutional treatment as were present before it. This fact is often overlooked by physicians, who, observing the improved condition of the patient after the operation, are too apt to relax their efforts in this direction. I know of no cases in which a successful issue more directly depends upon care and watchfulness in their after-treatment

than those in which tracheotomy has been performed to relieve the obstructive dyspnœa consequent upon diphtheritic or membranous laryngitis. The patient should be under the charge of an attendant or nurse who is skilled in the management of such cases, and is able to recognize and meet such complications as may arise. After the operation the patient should be placed in a room free from draughts, with a temperature of 70° to 75° F., and the air of the room should be rendered moist and warm by a vapor of steam. At the Children's Hospital of Philadelphia there is an apartment especially arranged for the treatment of cases after tracheotomy; it is fitted with a steam apparatus, by means of which in a few minutes it can be filled with a vapor of steam and maintained at an even temperature. I think the large number of successful results of the operation at that institution is greatly due to this feature of the after-treatment. In private practice it is difficult to obtain these conditions, and as a substitute a framework may be fastened over the bed, over which sheets can be stretched, forming a tent; under this water may be kept boiling in a pan or vessel, or lime can be slaked; the vapor from the latter Cohen considers one of the most efficient solvents of the false membrane. A steam or hand atomizer should be used at frequent intervals, the spray being directed over the opening in the tracheotomy-tube. I have found great advantage from the use of Parker's soda solution, which is as follows:

℞. Sodii carbonatis . . . . . ʒj–ʒij.
Glycerini . . . . . fʒij.
Aquæ . . . . . q. s. ad fʒvj.—M.

To this solution a small quantity of carbolic acid may be added, without in any way affecting its solvent action on the false membrane or mucus. I am so firmly convinced of the utility of this solution that in all cases I have it constantly used in the steam or hand atomizer, and also have it introduced into the tracheal tube by means of a feather or brush. The use of the steam spray and the soda solution is especially important in cases in which there is little tendency to expectorate mucus or false membrane—dry cases—or in those in which the inner tube is found clogged with inspissated mucus or membrane. Peroxide of hydrogen in 15-volume solution, either used in full strength or diluted to one-half, one-third, or one-fourth, is also used with advantage in these cases. It has a decided action upon the membrane, and it may be applied with a brush, feather, or spray. It is a good omen if the child coughs or expectorates false membrane after the tracheotomy-tube is introduced, for moist cases in which these conditions obtain, as a rule, are much more favorable than dry cases or those in which there is little tendency to expectoration. This clinical observation was, as far as I know, first made by Cohen some years ago, and I have since personally seen numerous instances which attested its accuracy. In a series of cases reported by Lovett and Monroe all those in which there was suppression of the discharge from the tracheotomy-tube, which were classed as dry cases, terminated fatally. My own experience has been the same, with one exception. This was in the case of a girl three years of age, who was admitted to the Children's Hospital in September, 1887, with extreme dyspnœa from diphtheritic laryngitis. I performed tracheotomy: when the trachea was opened there was no expectoration, and it seemed to be a typical dry case; an unfavorable prognosis was accordingly given. This condition continued for fourteen hours, when, under the persistent use of steam spray and soda solution, and frequent moistening of the trachea through the tube by means of a feather dipped in the soda solution, the child began to expectorate mucus and shreds

of membrane, and continued to do so for several days. She finally recovered, the tube being removed on the tenth day.

Care of the Tracheotomy-tube.—The nurse or attendant having charge of the case should remove the inner tube of the tracheotomy-tube every hour or half hour for the first twenty-four hours, and after this time at less frequent intervals, and thoroughly cleanse it with a feather or brush dipped in soda solution, removing any membrane or mucus which adheres to its inner surface. She must be cautioned not to allow the inner tube to remain out more than a few minutes at a time, for I have seen cases in which it was carelessly allowed to remain out for several hours, where, owing to the tendency of the mucus to become inspissated in the outer tube, it could not be reintroduced and the outer tube had to be removed from the wound and cleaned before it could be replaced. The nurse should also be instructed to introduce a soft feather moistened with soda solution into the tube every half hour, if the case be one in which there is little discharge from the tube; if there is membrane or mucus loose in the trachea or tube, as evidenced by noisy respiration, this manipulation will facilitate its removal. If a portion of membrane becomes impacted in the tube, its presence will be shown by more or less marked dyspnœa; this can generally be relieved by removing the inner tube and cleansing it. If the membrane is in the trachea below the tube, it may be extracted by means of a feather or the curved tracheal forceps. If all these means fail and the breathing becomes more embarrassed, the surgeon should remove the tracheotomy-tube, introduce the tracheal dilator, and search for and remove the obstructing membrane, after the removal of which the tube should be replaced.

Changing the Tracheotomy-tube.—If no indication exists for removing the tracheotomy-tube earlier, it should be removed on the third or fourth day and replaced by a fresh one. At this time the surgeon may take the opportunity of testing the breathing capacity through the larynx by placing a pad of moist lint over the wound in the neck; if the child breathes comfortably without the tube, it may be kept out of the wound for a few minutes while it is being cleansed and fresh tapes attached, or a fresh tube may be prepared, and it should then be introduced. There is usually little difficulty experienced in introducing a tube at this time, for the tissues in the region of the wound have become glued together by inflammatory lymph, leaving a sinus leading down to the wound in the trachea. If there is not any special indication for its removal, the tube need not be again changed for two or three days; and at this time it can be left out of the trachea for a longer period if the child breathes comfortably without it and there is evidence that air passes freely through the larynx. I consider it a good plan to permit the nurse or attendant to introduce the tube under the surgeon's direction, so that in the event of its accidental displacement or necessary removal on account of obstruction by membrane, she will have learned the way into the trachea and will feel confident of her ability to replace it. It is often well, as the case progresses, to close the opening in the tube by a cork, which may be kept in place for a short time, and thus test the permeability of the respiratory tract above the wound.

Permanent Removal of the Tracheotomy-tube.—When it is found that the child can breathe comfortably with the tube stopped, showing that air is passing through the larynx, it is advisable to attempt the permanent removal of the tube. The permanent removal of the tube is most important if there is no further indication for its use, for its presence may set up tracheitis, which is evidenced by the profuse discharge of glairy mucus; and it is a well-established fact that tracheotomy-tubes which are retained for a long time are, in many cases, finally removed with the greatest difficulty.

It is difficult to fix a definite time for the permanent removal of the tracheotomy-tube in all cases, as the procedure depends largely upon the state of the patient and upon the local condition of the trachea and larynx. I have seen tubes permanently removed as early as the third and as late as the sixtieth day, and there are numerous recorded cases in which it has been impossible to remove them for months or even years. In cases of tracheotomy for diphtheritic or membranous laryngitis I think the tube can usually be removed permanently from the eighth to the fifteenth day. The wound, after the removal of the tracheotomy-tube, contracts rapidly, but for a few days the breathing is carried on through both the wound and the nose and mouth. Usually from the fifth to the eighth day after the removal of the tube the wound is so far healed that no air passes through it. The superficial wound may be dressed with a piece of lint spread with boracic ointment, and held in position by a strip of adhesive plaster until it is completely healed.

Too much care cannot be exercised in the thorough cleansing of tracheotomy-tubes which have been used. Before they are employed in other cases they should be boiled in soda solution for fifteen minutes, and then dried and polished.

Feeding of Patients after Tracheotomy.—It is the general experience of surgeons that children wearing tracheotomy-tubes take their nourishment well and have no difficulty in swallowing fluids, so that they can be given a milk diet or one of semi-solids, or even one of solids if, for any reason, the latter is considered desirable. It is also important to remember that such cases should be given the most nutritious diet; if the appetite fails or the child refuses to take a sufficient quantity of nourishment, alcohol in some form should be administered, and rectal feeding or the injection of fluids into the stomach by means of an œsophageal tube should be resorted to. Regurgitation of fluids through the tube or wound sometimes occurs a few days after the operation, owing to paralysis of the muscles of the palate; under such circumstances the patient should first be given a diet of semi-solids, and if this be regurgitated through the tube, the nourishment should be given by means of the œsophageal tube, and rectal feeding should be employed at the same time. If the diet is restricted to semi-solids or solids, the thirst may be allayed by allowing the patient to swallow small pieces of ice, or by the use of enemata of water; care should be taken that small quantities only are given at a time. Regurgitation of fluids through the tube or wound is not a favorable symptom; but an unfavorable prognosis should not be given from this symptom alone, as I have seen a number of cases in which this complication existed both before and after the removal of the tube, but in which, by careful feeding, recovery followed.

Causes of Death after Tracheotomy.—After the operation of tracheotomy many cases do well for a time and then terminate fatally from septicæmia, from diphtheritic poisoning, from pneumonia, from heart-clot, from recurrent obstruction due to extension of the membrane below the seat of the operation into the trachea and bronchial tubes, and from diphtheritic paralysis. Death from any of the above causes, except recurrent obstruction, is usually devoid of the signs of suffering, and the operation may be credited with prolonging life and rendering the mode of death much less distressing. Many cases die of heart-clot or pneumonia, and it is a question whether deaths from this complication are more frequent after tracheotomy than in cases of diphtheria in which the operation has not been performed. In diphtheritic cases the open wound exposes a surface for the absorption of the poisons, as is seen by the occasional development on the wound of diphtheritic membrane, and in this way the operation may be said to introduce a small additional element of danger; but it is a

comparatively insignificant one, and is not to be compared with the immediately dangerous symptom for the relief of which it was undertaken.

Croup supervening upon the exanthemata is not, as a rule, amenable to tracheotomy, according to Cohen. Lovett and Munroe mention 17 cases in which tracheotomy was performed during the course of some one of the exanthemata; 10 of these, in which croup complicated measles, gave 5 recoveries; in the other 7 cases, in which croup complicated whooping-cough, mumps, or scarlet fever, the operation failed to save life. I have had 1 successful result out of 3 tracheotomies performed for croup complicating measles in a very fatal epidemic of this disease in the Children's Home in Philadelphia. My own experience with this class of cases has been such that I do not refuse to operate if the symptoms calling for operation exist.

Complications after Tracheotomy.—*Diphtheritic infection of the wound* is a complication which is occasionally seen after tracheotomy for diphtheritic laryngitis, and it is one which is not necessarily fatal, although it adds somewhat to the gravity of the case, for I have seen patients recover in whom this condition was well developed. In the treatment the local application to the wound of 1 part of hydrochloric acid to 2 parts of glycerin has been followed by good results. Peroxide of hydrogen may also be applied to the surface of the wound, or the membrane may be scraped away with a curette, and the surface then swabbed with a solution of bichloride of mercury 1 : 500. Diphtheritic infection of the wound should not be confounded with sloughing of the wound, with a discharge of thin, offensive pus—a condition which is sometimes seen in poorly-nourished and weak children.

Inflammatory œdema of the neck is apt to occur in ill-nourished children, and it is only a source of danger when it becomes well marked; for in the majority of cases of tracheotomy it exists in the immediate neighborhood of the wound to a limited extent. It may, however, involve the tissues of the neck to such an extent that the tube is lifted out of the tracheal wound by the swelling of the tissues, and dyspnœa occurs, in which event a longer tube should be introduced. The treatment of this complication consists in the application of lead-water and laudanum to the inflamed area, and if there is evidence of diffused abscess a free incision should be made at the earliest opportunity.

Erysipelas also may attack the tracheotomy wound: it is generally superficial, but may involve the deeper parts. The treatment is the same as for erysipelas complicating other wounds.

Secondary hæmorrhage is a rare complication after tracheotomy, but may arise from vessels divided or injured during the operation, or from ulcerative perforation of the trachea from pressure of the lower extremity of a badly-fitting tracheotomy-tube, causing erosion of some of the great vessels of the neck. I have seen two cases in which death resulted from hæmorrhage after the operation: in one case a profuse consecutive hæmorrhage occurred six hours after the operation, and speedily proved fatal. I assisted in the operation in this case, and although there was free venous hæmorrhage at the time, it was thoroughly controlled before the tracheotomy-tube was introduced; and the unfortunate result, in my mind, can be accounted for only by the displacement of one of the several ligatures which had been applied to the injured vessels. The other was that of an infant six months old, in whom, at the time of the operation, there was free venous bleeding, which was controlled by ligatures. In this case on the sixth day profuse hæmorrhage took place from the tracheotomy wound and tube, and rapidly proved fatal. M. d'Heilly reports a fatal case in a child in whom hæmorrhage arose from an ulceration of the trachea, which had extended to the innominate artery, and was

caused by the end of the tracheotomy-tube. Dr. Hutton reports a similar case in which death occurred from hæmorrhage; and several other cases, in which the innominate artery was opened in the same manner, have been recorded. If the bleeding arises from smaller vessels, it is often possible to control it by the application of ligatures or by the use of the galvano-cautery; but hæmorrhage from the innominate artery is so profuse that it has always rapidly proved fatal before any attempt could be made to control it.

Surgical emphysema, starting from the region of the wound, is occasionally met with after tracheotomy: the presence of air in the tissues is explained by the fact that during the violent inspiratory efforts in obstruction of the larynx there is more or less of a vacuum produced in the chest, and the air is sucked into the cellular tissues of the neck and diffused throughout the tissues generally. It is said to be more common after tracheotomies in which the incision in the treachea is not in the median line and does not correspond with the wound in the soft parts in front of the trachea. A moderate amount of emphysema in the immediate neighborhood of the wound is not uncommon, but sometimes the condition is developed to such an extent that the cellular tissues of the neck, face, arms, chest, and abdomen become greatly distended with air. I once saw a case in which these parts were all involved, and the crepitation of the air in the cellular tissue at the ends of the fingers could be distinctly felt. In this case there was also recurrent dyspnœa, which was probably due to mediastinal emphysema. Champneys has reported 28 cases in which autopsies had been made after tracheotomy, in which the operation was performed for diphtheritic laryngitis. In 16 of these cases emphysema of the mediastinum was present. This condition has also been found in patients dying from diphtheria in whom tracheotomy had not been performed. Emphysema, when developed to a moderate extent, seems to do no harm, as the air is usually quickly absorbed; but when it becomes general and the mediastinum is involved, marked dyspnœa is apt to develop and the prognosis is extremely grave.

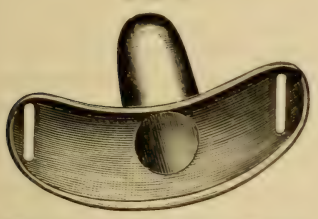
Granulations about the tracheal wound occur in certain cases where there seems to be a peculiar hypersensitive condition of the mucous membrane of the trachea. These granulations are most commonly seen in cases where tubes have been worn for a long time, and are often one cause of difficulty in their permanent removal. The presence of granulations may be suspected if the child coughs up blood-stained secretions after the tube has been changed. Withdrawal of the tube and inspection of the wound will often disclose the presence of granulations attached to the edges of the tracheal wound or growing from the trachea in the region of the wound. The treatment of this condition consists in the application of a 30-grain solution of nitrate of silver; or they may be touched with a solid stick of nitrate of silver; or the wound may be freely exposed by the introduction of a tracheal dilator, and the granulations seized with forceps and removed with scissors, or scraped away with a curette.

Ulceration of the trachea may arise from improperly-shaped or badly-fitting tracheotomy-tubes; it may be suspected when the tube, if a silver one, becomes blackened, and there are fetor of the breath and expectoration of purulent and blood-stained discharge. This complication is not so apt to occur at the present time under the use of the improved tracheotomy-tubes which are now employed. The treatment of this condition consists in first removing the badly-fitting tube and replacing it by a properly-fitting one, and, further, in the application to the ulcerated surface of a 10-grain solution of nitrate of silver.

Difficulties in the Permanent Removal of the Tracheotomy-tube.—In the great majority of cases the tracheotomy-tube can be permanently dispensed

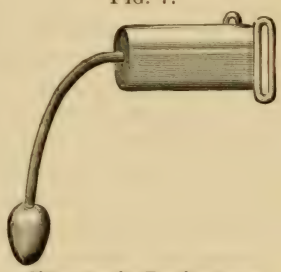
with in from eight to fifteen days, yet there are occasionally met instances in which this cannot be accomplished for months or even years; a few cases have been recorded in which its final removal was never satisfactorily accomplished. The difficulty of the permanent removal of the tracheotomy-tube is due, in some cases, to mechanical causes, such as the growth of granulations in the trachea or wound or in the larynx, inflammatory hypertrophy of the vocal cords, adhesion between the cords, paralysis of the posterior crico-arytenoid muscles, spasm of the glottis, or stenosis of the trachea at the seat of operation. Dr. Emil Kohl, in an exhaustive article upon this subject, mentions, as also causes of delay or difficulty in removing the tracheotomy-tube, prolonged diphtheria, re-formation of the diphtheritic membrane, changes in the shape of the trachea or larynx from the operation or from the wearing of the tube, and relaxations of the anterior wall of the trachea. Where the difficulty in the permanent removal of the tube is due to the presence of granulations in the trachea or larynx, after their removal by some of the methods before mentioned the physician is usually able to dispense with the tube. Where stenosis of the trachea or larynx exists and prevents the permanent removal of the tube, the parts may be gradually dilated by the use of bougies, or, better, by the introduction of an intubation-tube after the removal of the tracheotomy-tube: the wound in the neck can then be plugged with a nipple attached to a shield (Fig. 6), or with

FIG. 6.



Obturator for Tracheotomy Wound.

FIG. 7.



Obturator for Tracheotomy Wound.

an instrument shown in Fig. 7, to keep the wound from healing until it is certain that there will be no necessity for the reintroduction of the tracheotomy-tube. The intubation-tube may be worn for some days or weeks, and then removed, and if the breathing is satisfactorily carried on with the wound in the neck plugged, as above described, the shield with the nipple may be removed, and the wound be allowed to heal. By this method of treatment I have been able to finally remove tracheotomy-tubes which had been worn for a long time. I have had recently under my care a child of eighteen months of age in whom I was only able to remove the tracheotomy-tube permanently after sixty days by the use of an intubation-tube and obturator; and another case where a patient was finally able to dispense with a tube after having worn it for four years. In young children I have seen difficulty in the permanent removal of the tube from the fact that the trachea is very flexible, and from the fact that the wound in the soft parts in healing had become attached to the tracheal wound, and in inspiration assumed a valvular form, allowing little air to enter the trachea.

If the tracheotomy-tube is removed before the larynx is clear, or while there is irregular action of the laryngeal muscles, dyspnœa soon becomes marked and necessitates its reintroduction. This can best be overcome by removing the tube from time to time, and trying to induce the child to learn again to breathe

through the larynx, or by introducing the intubation-tube for a time, and keeping the tracheal wound from healing until the breathing is again satisfactorily accomplished through the larynx.

Mr. Thomas Smith has shown that tracheotomy is apt to cause undue irritability and disorderly action of the muscles of the glottis, so as to interrupt their usual rhythm. Cohen says that the explanation of this phenomenon resides in the fact that the laryngeal muscles have lost their habit of contracting harmoniously with the needs of respiration, the patients being somewhat in the condition of those with paralysis of the vocal cords. Some patients can breathe comfortably without the tracheotomy-tube except during sleep. In explanation of these cases Mr. Thomas Smith suggests that the influence of the will may be necessary to regulate and secure due action of these muscles, the perfection of whose movements has been impaired, and that on this account inspiration through the larynx during sleep is impossible.

Mental agitation plays an important part in preventing the removal of the tube in many cases, for we often see children who can breathe comfortably through the larynx when the tube is plugged, but who, when it has been removed and the tracheal wound has been closed with a pad or obturator, exhibit great mental agitation and develop such alarming symptoms of dyspnœa that the reintroduction of the tube becomes necessary. It is remarkable to observe how even a young child soon learns to depend upon the presence of the tube for breathing, and how he will resist its removal; he will often get into such a rage if it is withdrawn, that the rhythmical respiratory action may become so seriously embarrassed as to require its immediate replacing. Cases have been recorded where, even after the wound had healed, children could breathe comfortably only by having the tracheotomy-tube tied around the neck. Stevenson has made the observation that fright, upon the removal of the tracheotomy-tube in children, produces a nervous, excitable condition, irregular respiration, and sobbing, seeming to induce spasm of the glottis. The permanent removal of the tube, if there be no mechanical difficulty present, can usually, in most cases, be finally accomplished by gaining the confidence of the child, and by patience and perseverance in withdrawing the tube at intervals of gradually increasing length.

Post-tracheotomic Vegetations.—Under this title there have been described vegetations or granulations which occur in the trachea after the wound has cicatrized. These growths are more apt to occur in male children, and appear fifteen days to a month after the wound has healed. The most marked symptoms of this affection are embarrassed respiration with progressive dyspnœa. The first case of this kind was reported by Gigon, and since that time fourteen cases have been collected by Ross. Denger reported a case which died two weeks after the wound had healed, and in which an autopsy revealed a tumor of granular tissue in the trachea at the seat of the tracheotomy wound. The treatment of these growths consists in again performing tracheotomy, exposing them, and removing them with scissors or knife, cauterizing their bases, and introducing the tracheotomy-tube; if, after a short time, they show no tendency to recur, the tube should be removed and the wound allowed to heal.

Tracheotomy without Tubes.—Some surgeons, recognizing the amount of attention which patients require while wearing tracheotomy-tubes, and possibly over-estimating the dangers in their use and the difficulty which is sometimes experienced in their final removal, have recommended and practised the operation of tracheotomy without the use of the tube. Dr. Martin

has reported several cases in which he dispensed with the tracheotomy-tube, the edges of the tracheal wound being fastened to the skin by sutures. Other surgeons have recommended the removal of a small portion of the trachea on each side of the incision when no tube is to be used. I think there is little danger in the use of the tracheotomy-tubes which are now employed, if the precaution be taken to see that they fit the trachea well. The objection that more care is required in the after-treatment of the case while wearing the tube is not a valid one, as it seems to me that an equal amount of attention is required whether the tracheotomy-tube be used or dispensed with. The removal of a triangular portion of the trachea from each edge of the wound I do not recommend, as stenosis of the trachea at the point of operation is apt to result. The number of cases in which the use of a tracheotomy-tube has been entirely dispensed with has been so small that we cannot yet fairly judge of the value of the procedure. Personally, I am decidedly of opinion that the use of a well-fitting tube is a most important factor in a case of tracheotomy, and as such would most strongly recommend its employment.

Thermo-cautery in Tracheotomy.—The dread of hæmorrhage has led certain surgeons to substitute a thermo-cautery knife for the scalpel in the operation of tracheotomy. In 1870, Amussat first employed the galvano-cautery in tracheotomy, and this method also has been employed by Verneuil, Krishaber, and others.

Rapid Tracheotomy.—Fear of troublesome hæmorrhage has not deterred some surgeons from recommending a rapid tracheotomy by a single cut. Saint-Germain claims to have performed a number of such operations without a single serious accident. Mr. Durham has recommended a rapid tracheotomy, which he performs in the following manner: The surgeon stands upon the right side of the patient, and places his forefinger on the left side of the trachea and his thumb on the other side, so as to include between them the spot at which the trachea is to be opened. Firm pressure is made, and the trachea can be felt between the thumb and finger; the safety of the great vessels is ensured, as they are outside of the line of incision. By a succession of careful incisions the operator cuts down on the trachea, and when it is exposed he may open it directly or fix it with a tenaculum before opening it. Mr. Durham claims to have operated on a number of cases without any untoward results. This rapid method of performing tracheotomy has not been very generally employed, and I cannot appreciate its superiority over the slower and safer method of dissecting carefully down to the trachea and opening it, except in certain rare cases of great urgency. I therefore am of the opinion that rapid tracheotomy will never supersede the latter operation, which has the advantage of enabling the surgeon to recognize and avoid structures the wounding of which would be dangerous.

Condition of Patients after Recovery from Tracheotomy.—The condition of patients after recovery from tracheotomy performed for diphtheritic or membranous laryngitis is a matter of great interest. As far as my personal observation goes, the voice in these cases seems to be unimpaired, and they do not seem to be more liable to laryngeal affections than those in whom recovery has occurred without operative interference. The rare occurrence of post-tracheotomy vegetations has been already referred to. Drs. Lovett and Munroe have made some very valuable observations bearing upon this subject: in 56 cases where tracheotomy had been performed more than a year previously, which they investigated with reference to the effect of the operation upon the voice and general health of the patient, 53 were in good health, and none of

them had had a second attack sufficient to call for surgical aid. The voice was clear in all but 4 cases; 6 patients were liable to sore throat; 3 were not in good health, 1 having phthisis, but without any laryngeal symptoms, 1 had a hoarse and croupy voice, and the third was a delicate boy who was constantly ill.

INTUBATION OF THE LARYNX.

By HENRY R. WHARTON, M. D.,

Philadelphia.

Intubation of the Larynx is an operation by which a metallic tube is passed through the mouth into the larynx for the relief of dyspnœa resulting from laryngeal stenosis. This procedure for the relief of dyspnœa depending upon croup was first employed by Bouchut of Paris in 1858. He used a hollow metallic cylinder about an inch in length, which was pressed into the larynx and allowed to remain, and had attached to it a silken thread to facilitate its removal and to prevent its passing down into the trachea. Although, as far as known, this was the first formal method of treating dyspnœa in cases of croup by the introduction of a metallic tube into the larynx, the procedure of introducing a tube into the larynx to relieve dyspnœa arising from other causes, known as catheterization of the larynx, had been employed by many surgeons before this time. The results of Bouchut's cases were not sufficiently satisfactory to recommend its general adoption, and the procedure fell into disuse. Dr. Joseph O'Dwyer of New York, in 1880, after numerous experiments upon dead subjects in the autopsy-room of the New York Foundling Asylum, finally reintroduced this operation as a means of dealing with dyspnœa resulting from laryngeal stenosis. Numerous modifications of the tube were made, and it is due to the patient and careful work of O'Dwyer that the operation has become recognized by the profession as a legitimate procedure in the treatment of the symptoms arising from laryngeal obstruction. The operation of intubation of the larynx, which has been employed in many thousands of cases in this country and abroad, has now taken its place with tracheotomy as a well-recognized surgical procedure in the treatment of obstructive dyspnœa.

Indications for Intubation.—The indications for intubation of the larynx in cases of diphtheritic or membranous croup are similar to those which are recognized as indications for the operation of tracheotomy in the same affection—namely, labored breathing, retraction of the lower ribs and supraclavicular spaces, retraction of the tissues of the suprasternal notch, cyanosis, restlessness, inability to sleep, or, in other words, marked symptoms of obstructive dyspnœa.

Prognosis in Intubation.—An examination of large numbers of reported cases of intubation of the larynx shows that the number of recoveries following the operation is very similar to the number following tracheotomy. Ball, in a collection of 4217 cases of intubation gathered from American and European sources, found that there were 1285 recoveries, or about 30.4 per cent. Ball also presents some statistics bearing upon the age of the patients. In a total number of 1540 cases, tabulated according to age, there were 474 recoveries, or 30.7 per cent. The percentage of recoveries at each age is shown in the following table:

60	cases	under	1	year of age,	11	recoveries,	or 18.3	per cent.
253	"	"	2	years of age,	48	"	or 19.0	"
306	"	"	3	"	67	"	or 21.9	"
326	"	"	4	"	98	"	or 30.0	"
231	"	"	5	"	93	"	or 40.0	"
127	"	"	6	"	48	"	or 37.8	"
83	"	"	7	"	37	"	or 44.5	"
80	"	"	8	"	41	"	or 51.2	"
26	"	"	9	"	13	"	or 50.0	"
23	"	"	10	"	7	"	or 30.0	"
7	"	"	11	"	3	"	or 42.8	"
7	"	"	12	"	4	"	or 57.1	"
11	"	over	12	"	4	"	or 36.3	"

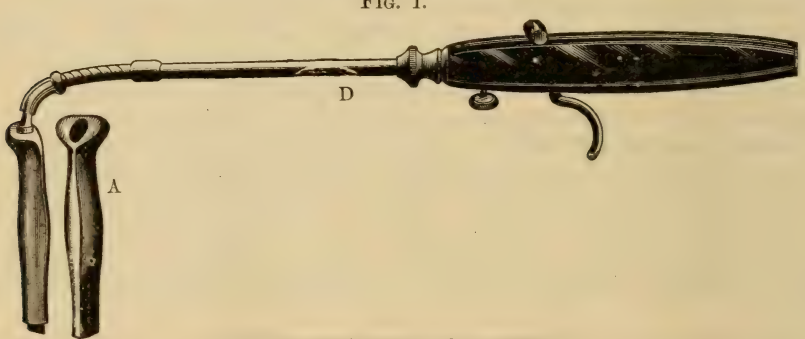
From the above table it will be seen that intubation gives better results than tracheotomy in the first and second years of life; from this age the difference between the two operations, as far as recoveries go, is not very marked. It must be remembered, however, that the statistics of intubation as compared with tracheotomy are not entirely to be relied upon, for many operators perform intubation at a time when the dyspnœa is not extremely urgent, whereas the same operator would hesitate to recommend tracheotomy; so that it is probable that many of the milder cases are intubated, whereas many of the very urgent ones are reserved for tracheotomy.

Instruments required for Intubation.—Instruments required for intubation are:

Intubation-tubes of various sizes.
An introducer.
An extractor.
A mouth-gag.
A gauge.
Fine braided silk.

The intubation-tubes (Fig. 1) for children are usually six in number, of different sizes, adapted to children from one to twelve years of age. The tube

FIG. 1.

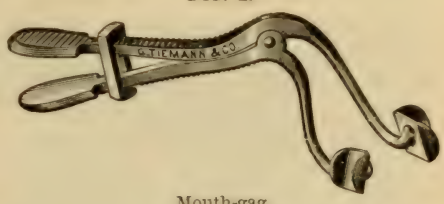


The Intubation-tube and Introducer.

now generally employed consists of a metal cylinder which bulges near its centre, and is provided with a collar or head to rest upon the false vocal cords; it is irregularly quadrangular, one angle resting between the arytenoid cartilages, and its opposite angle bevelled so as to better allow of the closure of the epiglottis over the aperture of the tube; the tubes are gold-plated, and each is provided with an obturator, which has a blunt extremity. Just below the head the tube is of small diameter to avoid injurious pressure on the vocal

cords. About midway the wall of the tube is increased to its greatest diameter, which bulging serves to maintain it in position during coughing and increases the weight to be expelled. Through the edge of the collar on each tube there is a small perforation through which the strand of fine braided silk is passed, which serves to remove the tube if in its introduction it should be passed into the pharynx or œsophagus instead of the larynx, or if from sudden obstruction it has to be hurriedly withdrawn.

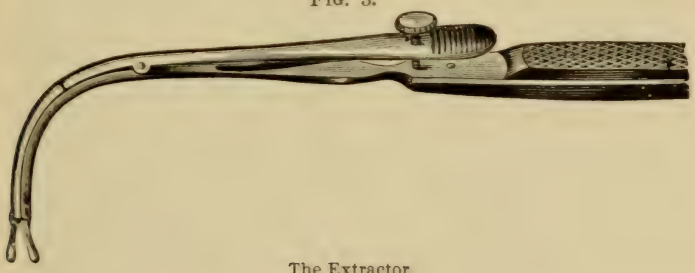
Fig. 2.



Mouth-gag.

The introducer (Fig. 1) consists of a handle and a staff which is curved to a right angle at its extremity, which has a screw that attaches it to the

Fig. 3.



The Extractor.

obturator, and a sliding gear for detaching the obturator from the tube when it is placed in the larynx.

Mouth-gags of various kinds may be used: the one generally supplied with intubation sets is that shown in Fig. 2, which is a self-retaining instrument.

Fig. 4.



Gauge.

The extractor is also curved on a right angle, and has at its extremity a small forceps with duckbill blades, which are made to separate and apply themselves to the interior surface of the tube with sufficient firmness to withdraw it (Fig. 3).

The gauge is to determine from the age of the child the size of the tube to be employed (Fig. 4).

Preparations for Intubation.—It is important that the following preparations should be made, so that the actual introduction of the intubation-tube may occupy as little time as possible, for it should be remembered that when the intubation-tube enters the larynx breathing is arrested until the obturator is removed, and therefore everything should be in readiness and all manipulations should be as rapid as consistent with accuracy. The time usually required after the mouth-gag has been adjusted for the introduction of the intubation-tube and withdrawal of the obturator is from five to ten seconds.

Before attempting to introduce an intubation-tube the surgeon should select a tube of suitable size for the age of the patient, and should have a strand of fine braided silk about two feet in length passed through the eyelet and secured with a knot. Having attached the tube by means of the obturator to the introducer, he should next see that it can be freed from the obturator by working the trigger. The mouth-

gag should also be examined to see that it is in proper working order, and this, with the tube and introducer, should be placed in a basin of warm water. The surgeon should next protect the index finger of the left hand, which is to be passed into the mouth of the patient, by wrapping it for an inch or an inch and a half in the region of the second joint with rubber or adhesive plaster, or a metal shield may be employed. This is an important precaution to prevent the patient from biting the finger in case the mouth-gag should slip, for a bite from the teeth, which are often very foul in these cases, is liable to be followed by serious consequences: a case has been recorded of a fatal result following such an injury received while performing intubation.

Position of Patient for Intubation.—The child should be taken upon the lap of the nurse and wrapped in a blanket, which should swathe it from the neck to the heels, and the nurse should grasp the child's elbows outside of the blanket and hold them firmly, but should not press them against the chest in such a way as to embarrass the respiratory movements; at the same time the legs of the patient are secured by being held between the knees of the nurse. The head of the patient should next be secured by being held between the open hands of the assistant placed upon the sides of the head and cheeks; the left hand of the assistant may also be used in steadying the mouth-gag after it has been introduced (Plate XII).

The patient should be held straight, and should not be allowed to lean back so as to get out of the operator's reach. Northrup well describes the proper position of the child for intubation when he says: "The position of the child should be as though it hung from the top of the head." This is unquestionably the best position in which to place the child for intubation, but it is possible to introduce the tube with the child in the recumbent posture: this I have done on several occasions when, from the condition of the circulation, I did not think it advisable to lift the child to a sitting posture; and in the Boston City Hospital, Dr. Lovett reports that intubation has also been performed in a number of cases with the patient supine; but under ordinary circumstances the position described above will be found most convenient.

Operation of Intubation.—The child being held as described above, facing the surgeon, who sits upon a chair within easy reach of the patient, the assistant fixes the head, and the surgeon opens the mouth and introduces the blades of the mouth-gag between the molar teeth on the left side; the blades are next opened by compressing the handles of the gag, and the assistant should then hold the gag steady with the fingers of the left hand. Children often struggle at this time and resist the introduction of the mouth-gag; hence it is better to open the jaws with the handle of a spoon introduced between them, even with the exercise of some force, and to introduce the gag, than to allow the child to become exhausted by struggling against ineffectual attempts to introduce it without the use of force. When the mouth has been opened the surgeon passes the index finger of the left hand into the pharynx and feels for the epiglottis, which is hooked forward by the end of the finger. The tube attached to the introducer is next passed into the mouth and carried back to the pharynx, the operator being careful to see that it hugs the base of the tongue in the middle line, that the handle is depressed well upon the child's chest, and that the silken thread is free. When the extremity of the tube comes in contact with the end of the finger holding the epiglottis, the handle should be raised as it engages in the larynx and descends into this organ; and as it is pushed downward into place the finger is placed upon the head of the tube to fix it and prevent its being withdrawn with the obturator; the trigger is next pressed, and the introducer and obturator are drawn from the mouth by depressing the handle

PLATE XII.



INTUBATION. (Inserting the Tube.)

upon the chest, and at the same time the tube should be pressed well down into the larynx with the finger which rests upon its head. A caution should here be given as to the importance of using little force in pressing the tube home after it engages in the larynx: no more force should be used than in passing the catheter or bougie into the urethra; and if it is found that the tube is too large to be passed into the larynx without the exercise of great force, it should be withdrawn and a smaller one attached to the instrument and introduced. As soon as the obturator has been withdrawn the child makes a deep inspiration: at the first expiratory effort there is generally coughed up false membrane or muco-purulent matter, and when the tube has become cleared of this the respiration is usually satisfactorily carried on. If, on the other hand, after withdrawing the obturator, the dyspnœa is not relieved by the expiratory efforts of the child, the tube should be removed by means of the thread and examined. If its canal is clear, showing that no mass of membrane is occluding it, and the dyspnœa does not decrease, it is pretty good evidence that the obstruction exists below the point to which the intubation-tube extends: it is therefore better to make no further attempt to introduce the intubation-tube, but to perform tracheotomy promptly. Before removing the mouth-gag it is well to introduce the index-finger of the left hand to feel that the tube is in place and has not been disturbed by the coughing efforts.

The management of the silken thread attached to the tube is a matter of some importance. Some operators, as soon as the tube is properly placed, cut the loop of thread, and, with the finger resting upon the head of the tube, pull upon one end of the loop and withdraw it. This is done to relieve the irritation of the fauces which the thread sometimes causes, and to prevent the child seizing it and pulling out the tube. Other operators prefer to leave the thread in place for some hours or days, securing the loop around the ear so that it cannot become loose; and in the event of the tube becoming blocked with membrane and not being coughed out, it can be removed by traction upon the thread. To prevent the irritation of the fauces and gagging which the thread sometimes causes, it may be passed through the posterior nares and brought out at the anterior nares, and secured to the ear or the face by a strip of plaster. I usually leave the thread in place for twelve or twenty-four hours, bringing it out of the mouth and attaching it by the loop around the ear, and placing a few strips of adhesive or rubber plaster over the thread from the ear to the angle of the mouth, to prevent the child grasping it and displacing the tube. Where it is possible, I also pass the thread between the molar or premolar teeth to prevent the child from biting it in two. When the child shows a tendency to grasp the thread, it is well to enclose the hands in stockings and secure them around the wrists.

It is quite possible in introducing an intubation-tube to pass it into the pharynx; and if this happens, as soon as the obturator is withdrawn the error is discovered and the tube should be removed and reattached to the introducer, and another attempt made to pass it into the larynx. This error, I am sure, often occurs in the hands of inexperienced operators by not being careful to hug the base of the tongue closely with the end of the tube, by not keeping strictly in the median line, and by disregarding the position of the tip of the index finger of the left hand, which is held in contact with the epiglottis and is a guide to the opening of the larynx.

Accidents during and after Intubation.—It is well for the operator to remember that certain accidents may occur during the operation of intubation, such as pushing a mass of membrane down into the trachea before the tube, or a too deep insertion of the tube, so that its head passes below the vocal

cords: these accidents have been reported, but I must confess that I have never had a serious accident occur during the operation. The pushing of a mass of membrane down before the tube is likely to embarrass the respiration so seriously that in the violent respiratory efforts of the child the tube is apt to be forced out of the larynx; if the tube is not forced out, it should be removed by means of the thread, and if the respiration is still embarrassed, tracheotomy should be resorted to. The accident of pushing the tube too deeply into the larynx is not likely to occur if a proper-sized and proper-shaped tube is employed. A tube which is too small may be easily forced between the vocal cords, or may be drawn downward by the inspiratory efforts of the child. Should this accident occur, the tube can usually be removed by traction upon the thread, and if a subsequent downward displacement occurs after the removal of the thread, it would be necessary to perform tracheotomy for its removal. Several instances have been reported in which this accident occurred and a resort to tracheotomy was necessary. In certain cases, after the tube has been retained for a few days, it is coughed up, and upon being replaced the same accident occurs: a larger tube should then be tried, and if it cannot be tolerated by the larynx, further attempts at intubation should be desisted from, and, if dyspnœa is still marked, tracheotomy should be resorted to. Another accident which sometimes occurs is the coughing up and swallowing of an intubation-tube which is not attached to a thread. The tube is usually passed through the alimentary canal without difficulty, and I know of no fatal result following the swallowing of an intubation-tube. Although I have never personally seen any accident happen during the operation of intubation or while the intubation-tube was in place, I always have at hand during the operation my tracheotomy case, so that I can promptly open the trachea if the indication exists, and would advise all operators to be similarly prepared.

After-treatment of Cases of Intubation.—Cases in which an intubation-tube has been introduced require most careful watching by a nurse who is competent to meet any emergency that may arise. If dyspnœa suddenly develops from the obstruction of the tube by a piece of membrane too large to pass, the nurse should be instructed to remove the tube, if the thread is still attached; or if the thread has been withdrawn she should invert the child, and by striking over the posterior portion of the chest she may be able to dislodge the tube. A case has been recently reported in which this manipulation by the nurse saved the patient's life. In the after-treatment of cases of intubation I have great faith in the efficacy of steam spray of Parker's soda solution (p. 302) or a spray of peroxide of hydrogen for its effect in dissolving membrane and liquefying the secretions. I usually have the spray used every half hour, or more frequently if there is little tendency to expectoration; in cases described as *dry* the use of the spray, I think, is most important.

Feeding of Intubation Cases.—The most difficult portion of the after-treatment of cases of intubation is the satisfactory feeding of the patient. From the interference with the act of deglutition caused by the presence of the tube and the imperfect action of the epiglottis, liquid nourishment is apt to pass into the larynx and set up coughing, which interferes with the taking of a sufficient quantity of nourishment. As many cases in which this operation is employed require large quantities of food from the nature of the disease for which the operation is performed, I think the difficulty of properly nourishing the patient constitutes the most serious objection to this operation. Children, as a rule, while wearing an intubation-tube, have difficulty in swallowing liquids, but there are occasionally seen cases in which liquids are swallowed without difficulty; therefore it is well to make a trial as to the feeding before

PLATE XIII.



METHOD OF FEEDING INFANT AFTER INTUBATION, WITH THE HEAD LOWER THAN THE BODY.

a special diet is ordered for any individual case. It is remarkable to observe how some children wearing intubation-tubes will learn to swallow with the tube in place. I have seen children who at first were unable to take liquid nourishment in a few days change their manner of swallowing, so that liquids could be taken without discomfort. If, upon trial, it is found that there is difficulty in swallowing liquids, I first order a diet of semi-solids, such as corn-starch, mush, milk-toast, rennet, puddings, soft-boiled eggs, and, as patients soon experience thirst, I order for them pieces of ice to be swallowed, or give enemata of water, an ounce to an ounce and a half, repeated at intervals. In young children, in whom a milk diet is essential, it will often be found that the child can swallow well if fed from a nursing-bottle, the head being dropped over the nurse's lap, so that it is lower than the body (Plate XIII).

This useful expedient was suggested by Casselberry of Chicago, who found that with the patient supine and the head lower than the body fluids could not pass into the larynx, but would be forced *up* the œsophagus into the stomach. If, however, all expedients fail as regards methods of feeding, as will be found in some cases, recourse must be had to the introduction of food by nutritious enemata.

Removal of Intubation-tubes.—The tube usually remains in place for some days, and is often coughed out as the swelling of the laryngeal tissues subsides. If the breathing is carried on satisfactorily, it need not be replaced; but it is well to remember that for a few days the dyspnœa is liable to return, so that the reintroduction of the tube may be necessitated; and the surgeon should be within reach during this time. If the tube has not been coughed out and the child's general condition is improved, the temperature having a tendency to reach the normal mark, at the end of three or four days I usually remove the tube; and if there is no return of the dyspnœa I do not reintroduce it, but have the case carefully watched, for the patient is not safe from recurrent dyspnœa for two or three days. If dyspnœa be present upon the withdrawal of the tube, I replace it promptly, and do not make another attempt at its permanent removal for two or three days. Usually in from five to ten days it can be dispensed with, although I have recently had a case in which the tube could not be permanently removed until the fifteenth day. After the expulsion or removal of the intubation-tube I continue to use the soda spray for two or three days, and the child must be carefully watched, so that it is not exposed to cold. I have noticed that in all cases in which recovery has followed intubation of the larynx there was present a considerable amount of hoarseness of the voice; but this in a few weeks finally disappears.

As the same intubation-tube may be used in many different cases, I think it most essential that every tube which is used should be thoroughly sterilized as soon as it is removed from the patient by being cleansed and boiled for a few minutes.

The removal of the intubation-tube is, I think, often more difficult than its original introduction. The child should be placed in the same position as described for its introduction; the mouth-gag should be used to separate the jaws; the index finger of the left hand, being protected, should be passed into the mouth and placed upon the head of the tube; the extractor should then be passed into the mouth, and with the finger on the head of the tube as a guide, the blades should be passed into the opening of the tube. The tube is grasped by pressing the lever which separates the blades, and, having a firm hold upon the tube, it is withdrawn by depressing the handle upon the chest of the patient. It is sometimes difficult to pass the blades into the opening in the tube, and during the withdrawal the blades may slip, losing their hold upon the

intubation-tube. If this accident occur, the tube can usually be hooked out of the mouth by the finger, which should follow it during its withdrawal.

Intubation of the larynx has added another very valuable surgical procedure to the treatment of dyspnœa arising from diphtheritic or membranous laryngitis and œdema or spasm of the glottis, and, although it does not entirely supersede the operation of tracheotomy in all cases, it is now employed in many cases where tracheotomy was formerly resorted to. Cases which seem to me favorable ones for intubation are those of membranous or diphtheritic laryngitis, where the obstruction comes on rapidly, and is probably largely due to œdema of the mucous membrane of the larynx. Children under two years of age are usually better subjects for intubation than for tracheotomy. Intubation also seems well adapted for cases of dyspnœa due to œdema of the larynx from burns or scalds or from the swallowing of corrosive liquids or the inhalation of irritating gases, unless there is at the same time marked œdema of the epiglottis and fauces. Cases unfavorable for intubation are those of diphtheria, in which there is much swelling of the tonsils and fauces, with profuse deposit of membrane; also those in which the dyspnœa comes on slowly, pointing to a gradual deposit in the larynx of a well-organized membrane. The great advantages offered by intubation are, that the operation itself is comparatively free from danger, it is a bloodless operation, and the consent of the parents for its performance can usually be obtained without difficulty; the inspired air enters the lungs warm and moist; and if this operation fails to relieve the patient it does not preclude a subsequent tracheotomy. Although some statistics have been presented from the Boston City Hospital showing that the prognosis in cases of tracheotomy after intubation is not favorable, my personal experience has been different, for I have resorted to tracheotomy in a number of patients in whom a fair trial of intubation had failed to relieve the dyspnœa, and the results following the operation were in no wise less satisfactory than those in which tracheotomy had primarily been performed.

Intubation in Stenosis of the Larynx.—The introduction of an intubation-tube for the purpose of relieving chronic stenosis of the glottis has been employed successfully in many cases; it has been proven that the tube in these cases can be worn for a considerable time without harm or inconvenience. It has been employed in cases of chronic syphilitic stenosis, in cases where there is difficulty in dispensing with the tracheotomy-tube from granulations growing in the region of the tracheal wound (see p. 308), in cases of cicatricial stenosis, swelling of the mucous membrane of the larynx below the cords, bilateral paralysis of the abductors, paresis of the cords from disease, or where there is dread of having the tracheotomy-tube removed. In such cases the manipulation for the introduction of the intubation-tube is similar to that in acute cases, with probably the difference that more force is justifiable in the introduction. The tube should be changed at intervals, a larger size being required from time to time. In chronic cases little difficulty is usually experienced in feeding the patients, as liquids are generally taken without difficulty after the first day or two.

PART IV.

GENERAL DISEASES NOT INFECTIOUS.

MALARIAL FEVER.

By W. S. THAYER, M. D.,

Baltimore.

Synonyms.—Intermittent fever; Swamp or Marsh fever; Paludism or Paludal fever; Fever and ague; Chills and fever.

The term "malaria," which has been applied in a general way to a variety of febrile and non-febrile processes, must now be limited to a certain definite class of febrile affections which we know to have a specific infectious origin. The specific micro-organisms which are the cause of these processes belong to the class of protozoa and inhabit the blood of the infected individual.

Etiology and Pathology.—The *geographical distribution* of the malarial fevers is a point of considerable interest, particularly inasmuch as it is not entirely constant. In Europe, France, Germany, and England are comparatively free from malarial fever, while in Southern Russia and Italy the disease is very frequent. In many parts of Africa and India some of the severest forms of malaria are seen. In this country there are various localities in which malaria is endemic, particularly in certain regions in the Southern States, in Louisiana, Mississippi, Arkansas, and Texas. In the low, marshy lands along the coast throughout the Southern and Central States there are many places in which malarial fevers are common. In parts of New England malaria also occurs, particularly in the Connecticut Valley, while of late a considerable number of cases has been seen along the course of the Charles River in Massachusetts. In New York City the disease is rare, though certain low-lying districts in the neighborhood give rise to a number of cases. In Philadelphia the disease is perhaps more frequently seen, but most of the cases in that city come from outlying districts. In parts of Baltimore also malarial fever occurs, though a great majority of the cases come from the districts bordering on Chesapeake Bay. In the Western States malaria is less common, but in certain parts about the Great Lakes it is more or less prevalent.

A very interesting point in connection with the geographical distribution of malarial fever is the manner in which the disease wanders from one region to another, diminishing greatly in intensity or almost dying out in a district where it has formerly been endemic, and developing perhaps in a region where it has been for many years an unknown disease. An instance of this is the appearance during the last five or six years of malarial fever along the basin of the Charles River in Massachusetts, where it had been for many years unknown. Again, in districts in which malarial fever has for years been endemic there seem to be cycles in which the intensity of the process increases and diminishes.

Malarial fever is particularly prevalent in low, swampy, and badly-drained districts, and especially in areas which are rich in vegetable matter and have

been allowed to fall out of cultivation. It is much more prevalent in tropical or semitropical regions, and is more severe in climates where the moisture is considerable. It has been thought that winds have possibly some connection with the carrying of the contagion; for instance, in some malarial districts the residents on one side of a stream may be relatively free from the disease, while those upon the other side, toward which the prevailing winds blow, may suffer considerably. The danger of contracting malarial fever is apparently greater among those living in the lower stories of a house than in the upper.

In temperate climates the frequency of the malarial fevers varies greatly with the *seasons*. The majority of cases occurs in the late summer and fall, though a certain number develops in the spring and early summer, while in the winter it is very rare. In tropical climates, where the disease occurs all the year round, the greater number of cases is seen in the fall and spring months.

The Specific Micro-organism.—All our accurate knowledge of the causal element of malarial fever dates from the discoveries of Laveran in 1880. While studying malarial fever in Algiers, Laveran discovered certain pigmented bodies in the blood of affected individuals. These bodies had long been observed by others, and by some accurately described, and even pictured, but, while the older observers considered them to be altered blood-corpuscles, Laveran recognized them as parasites, and asserted that they were the definite exciting agent of malarial fever. These discoveries have been confirmed by numerous other observers in Italy, the United States, Russia, Germany, and India. In this country Councilman, Abbott, Osler, James, and Dock have made valuable observations. Laveran and his school have published careful and accurate descriptions of the different forms of the parasite, which may be seen in the blood, but they assert that they are unable to associate any definite types of organism with distinct types of fever. From the observations which have been made, however, by the numerous Italian observers, led by Golgi, there can be to-day little doubt that certain definite types of the organism are associated with certain definite types of fever.

In this country, as in Italy, there are several main types of fever:

(1) The milder forms of intermittent fever, which form the great majority of the cases in the spring and early summer, but which occur at all malarial seasons: (*a*) tertian and double tertian (quotidian) fever; (*b*) quartan fever, with its combinations.

(2) The more severe, often more or less irregular, fevers which occur here, as in Italy, more commonly in the later summer and fall—the æstivo-autumnal fevers of the Italians, the tropical malaria of the Germans. This type of fever includes the so-called remittent malarial fevers as well as most of the cases of pernicious malaria and of the malarial cachexiæ. Some of the Italian observers have attempted to divide these fevers, again, into (*c*) quotidian fever, and (*d*) malignant tertian fever. In this country, however, we see probably only the quotidian type. With each of these types of fever is associated a distinct type of the specific micro-organism.

(*a*) *The Parasite of Tertian Fever.*—Golgi was the first observer who accurately described and differentiated the organisms of the tertian and of the quartan forms of malarial fever, and his admirable observations have remained practically unassailed. If we examine the blood from a case of tertian fever just after the paroxysm, we find in certain of the red blood-corpuscles small round, colorless bodies (Fig. 1, [1, 2, 3]) which appear to have a slight depression in the centre, and when stained in dried specimens show a paler central area with a darker periphery. These bodies, examined in the fresh specimen,

show active amœboid movements. A few hours later the organism will be found to have increased somewhat in size, and to contain a few fine brownish pigment-granules which dance actively under the eye (Fig. 1, [4]), the motion probably being due to undulatory movements in the protoplasm. On the day between the paroxysms the bodies will be found to have about half filled the red corpuscle (Fig. 1, [5]). They are still actively amœboid, and the number of pigment-granules has considerably increased. The red corpuscle at this stage will be seen to be a trifle larger than its unaffected neighbors, and to be considerably decolorized. On the day of the paroxysm

FIG. 1.



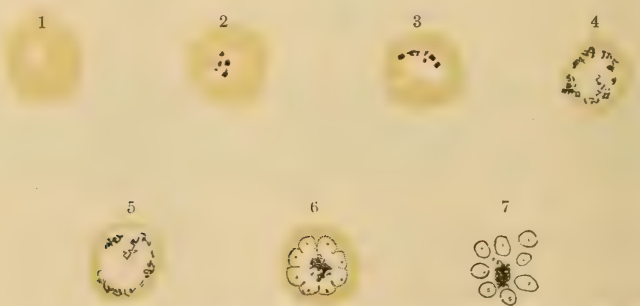
The Parasite of Tertian Intermittent Fever (drawings made from the blood of patients in the Johns Hopkins Hospital, with the camera lucida. Winckel, 1-14 oil immers. lens, 4 eye-piece): 1, 2, 3, hyaline intracellular amœboid bodies, seen during the febrile stage of the paroxysm; 4, 5, half-grown bodies seen on the day between paroxysms; 6, the same, further advanced; 7, full-grown body seen during the paroxysm; 8, segmenting body seen during the paroxysm; traces of the red corpuscle still seen about the organism; 9, 10, segmenting border further advanced; 11, 12, extracellular pigmented bodies, regenerative forms; 13, flagellate body (somewhat diagrammatic, not drawn with the camera lucida).

the organism has entirely filled and almost destroyed the red blood-corpuscle, which is represented only by a faint pale rim about the full-grown parasite, if indeed it has not entirely disappeared (Fig. 1, [7]). The pigment-granules may show at this stage a very active motion, but the amœboid movements of the organism as a whole are but little marked. At the time of the paroxysm an interesting change takes place: the pigment gathers together in a more or less solid clump, usually in the centre of the organism, while the rest of the protoplasm looks somewhat granular and shows a suggestion of

lines radiating outward from the centre (Fig. 1, [8]). This appearance gradually changes, the lines becoming more distinct (Fig. 1, [9]), until finally we see the central clump of pigment surrounded by from fifteen to twenty small ovoid or round glistening segments, each one having a central more refractive spot, and resembling strongly the hyaline bodies which we see immediately following the chill (Fig. 1, [10]). This segmentation of the organism is always coincident with the paroxysm, and the presence in the blood of a segmenting body is a sure indication that the paroxysm is present, or is about to occur. Immediately following the paroxysm fresh hyaline bodies appear in the red corpuscles. Though the invasion of the corpuscles by these fresh segments has never been actually observed, the evidence that this occurs is so strong that we can safely accept it as a fact. Besides these forms we see not infrequently small or large extra-cellular pigmented bodies; that is, organisms resembling exactly those within the red blood-corpuscles, excepting that they are free in the blood-current (Fig. 1, [11, 12]). These may be seen at times to break up into several smaller bodies, while at other times they may show a long, tail-like, non-motile process, containing sometimes a few pigment-granules. They are probably organisms which have escaped from the red corpuscles, or full-grown bodies which have broken up; they are considered to be degenerative forms. At times also we find the so-called flagellate bodies. Their development from the pigmented organism may indeed be observed, the pigment of the full-grown body becoming very actively motile, then collecting in the centre of the organism, while several long, thread-like flagella burst out of the body and move actively about among the surrounding corpuscles (Fig. 1, [13]). Sometimes we may see one of these flagella which has broken away from the organism and is moving rapidly through the field. This is also thought by the Italians to be a degenerative process. The characteristics of this form of organism, which is observed in tertian fever alone, are so marked that with a little study of the parasite one can make a definite diagnosis of the type of fever from an examination of the blood alone.

(*b*) *The Parasite of Quartan Fever.*—Quartan fever is not at all common in this country, but in the few cases which the writer has observed the organisms differ distinctly from the tertian parasite, and show accurately the characteristics described by Golgi. Here the first stage of the organism is similar to that observed in tertian fever, excepting that the amœboid move-

FIG. 2.



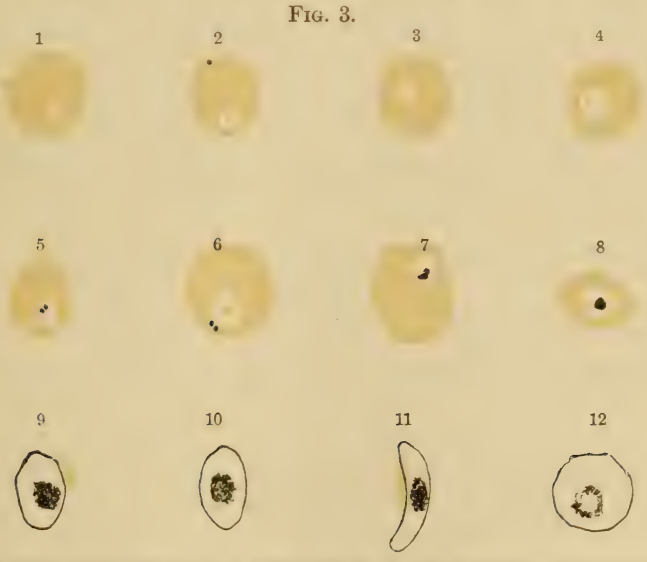
The Parasite of Quartan fever (drawings mainly after Marchiafava, Bignami, and Mannaberg): 1, hyaline amœboid intracellular body; 2, 3, 4, further stages in the growth of the body; 5, full-grown form; 6, 7, segmenting bodies.

ments are not so active. As the body develops the rods and clumps of pigment are larger and darker than those in tertian fever, while the amœboid

movement of the organism is relatively slight. The full-grown forms are materially smaller than in tertian fever, while the red blood-corpuscle, instead of being expanded and decolorized, appears at times shrunken about the body, and of a somewhat deeper old-brass color (Messingfarbe). In segmentation the organism divides into from six to ten different parts instead of twenty or thirty, as in the tertian form (Fig. 2, [1-7]).

(*c*) *The Organisms of the Æstivo-autumnal Fevers.*—The organisms associated with the æstivo-autumnal fevers have been carefully studied, but much remains to be done, particularly in this country. There is some difference of opinion as to whether there are not two types of organism associated with these fevers. Some Italian observers divide them into the quotidian and the malignant tertian organisms. The differences made out by the Italians are, however, very slight, and have not been observed in this country. In the first place, we see just after the paroxysm small hyaline bodies which may or may not be actively amœboid; these can sometimes be distinguished from those appearing in the initial stage of either tertian or quartan fever, in that they are generally somewhat smaller and have oftentimes a characteristic ring-like appearance (Fig. 3, [1-4]). In the early stages—during the first week, for instance—of an attack of this form of fever we may see only the hyaline, unpigmented forms, but commonly, if we observe carefully, we may see, some time after the exacerbation of temperature, shortly before the beginning of another, bodies which are a trifle larger than these smallest hyaline forms, and which contain one or two very minute pigment-granules lying near the periphery (Fig. 3, [3, 4]). Just before or during the paroxysm we may see

FIG. 3.



Parasites seen in Æstivo-autumnal Fever—tropical malaria. (Drawn with the camera lucida from the blood of patients in the Johns Hopkins Hospital; Winckel, 1-14 oil immersion lens, 4 eye-piece.): 1, 2, 3, hyaline, ring-like amœboid bodies seen in the blood toward the end of the paroxysm; 4, the same further developed; 5, 6, disc- and ring-shaped bodies with one or two small pigment-granules, seen shortly before a paroxysm; 7, full-grown body with central pigment-granules, seen during paroxysm; 8, full-grown body with central active pigment-corpuscle crumpled and shrunken; 9–12, crescentic and ovoid bodies with coarse central pigment. 9 and 11 show remains of the corpuscle (from a case of chronic malaria with normal temperature).

bodies with a small central clump of motile or non-motile pigment-granules lying usually in cells which are more or less shrunken and crumpled, and of a deeper color than the normal corpuscles (Messingfarbe). These bodies are

generally not half as large as the red corpuscle (Fig. 3, [8, 9]). After the first week or ten days of the disease, or after treatment has been begun, we see, however, certain very characteristic and easily recognizable forms which are only seen with this type of fever. These are, first, round or ovoid bodies about the size of a red blood-corpuscle, a little smaller or a little larger, with clear, rather highly refractive, waxy-looking protoplasm, and coarse dark pigment-granules, which are usually collected in a ring or a mass in the centre of the organism (Fig. 3, [9, 10, 12]). The granules are usually very slightly motile. At one side of the body we often see a small bib-like attachment which may show a slightly yellowish color. On examination this proves to be the remains of the red blood-corpuscle in which the organism has developed. In association with these are seen crescentic bodies (Fig. 3, [11]), the protoplasm of which shows the same characteristics as that in the forms above described, while the pigment is collected in the middle in a similar ring or bunch, and is but slightly motile. On the concave side of these crescents one may also often see a bib-like attachment, just as in the ovoid forms. At times during the examination of the fresh specimen we may see the change from an ovoid body into a crescent take place. The development of these forms from the hyaline bodies can be followed out on careful observation. They are thought by some to be a resting stage of the organism. Segmenting bodies are almost never seen in the circulating blood of this form of malarial fever, though the presence of the round intracellular bodies with central pigment is a sure sign that segmentation is going on elsewhere. It has been found by the Italians that after the accumulation of a few pigment-granules the organisms seek the internal organs, where segmentation takes place. The bodies are still small and contained within the red corpuscle. The pigment gathers in the centre, as in the other types of segmentation, while the segments are very small and rarely more than twelve in number. During the paroxysm we may see large numbers of leucocytes containing pigment granules and clumps which are probably the remains of segmenting organisms. Flagellate bodies may be observed here as in the tertian and quartan fevers, but only when ovoid and crescentic pigmented bodies are present. They may be seen to develop from the round bodies with central pigment.

Careful studies concerning the morphological characteristics of the malarial parasite have shown that it belongs to the class of Protozoa, and is possessed of a nucleus containing one or more nucleoli. At the time of sporullation this nucleus divides—according to some directly, according to others by karyokinesis.

Pathological Anatomy.—In the acutely fatal cases of malarial fever (pernicious malaria) certain fairly characteristic changes are found in the various organs.

The *brain* may show few changes. At times, however, there may be a slight subpial œdema, with hyperæmia of the cerebral substance and perhaps punctate hæmorrhages. Melanosis may be entirely absent. Microscopically, however, the changes are most characteristic. The cerebral capillaries are crowded with malarial parasites, which may be in all stages of development, though generally one of these phases is most marked. At times the organisms may not be so numerous, but free clumps of pigment may be found, and large endothelial cells and leucocytes containing pigment-clumps and red corpuscles. There is usually a marked granular and fatty degeneration of the endothelium of the vessels, a change upon which the punctate hæmorrhages may depend. These lesions are particularly marked in the comatose forms of pernicious malaria. In other forms the cerebral lesions may be much less marked.

The *spleen* is always enlarged: the capsule is tense; the parenchyma is cyanotic, of a slaty-gray color, and almost diffluent. In some cases of acute malaria death may occur from rupture of a greatly enlarged spleen. The pulp contains enormous numbers of red blood-corpuscles, many of which contain parasites. It also contains numerous large white elements rich in protoplasm, containing usually a single bladder-like nucleus, and at times coarse granulations. These elements are usually laden with pigment, which at times has the same arrangement as it does in the body of the parasite itself. Sometimes these cells may contain the entire red corpuscle with the organism. There may be free pigment in the intercellular spaces of the pulp. The small mononuclear elements and the lymphocytes of the follicles never contain pigment. The capillaries are usually filled with the plasmodia, while the splenic veins show relatively few, though they always contain large cells enclosing pigment or the remains of red blood-corpuscles.

The *liver* has usually a slaty-gray color. There is always cloudy swelling, while microscopically small areas of necrosis have been described by Guarnieri. The capillaries are filled with leucocytes which contain numerous pigmented bodies. Relatively few plasmodia are found in the blood-corpuscles in the vessels. Numerous liver-cells are found containing clumps of hæmatin and altered red corpuscles—a condition similar to that which has been found in pernicious anæmia, which, as Bignami suggests, may explain the polycholia which is commonly found in subjects who have died of pernicious malaria. On this probably depends the icteroid hue in severe malaria.

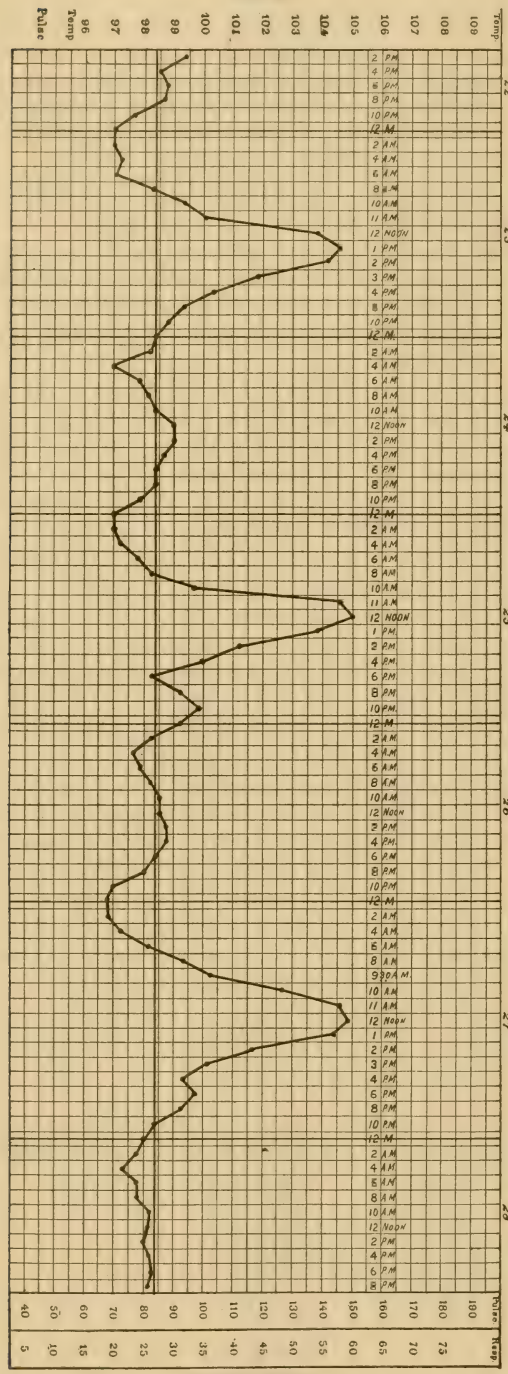
The *lungs* show in their capillaries numerous cells containing pigment-clumps and well-preserved parasites, though it is unusual to find pigment in the endothelial cells, in the capillaries, and smaller veins. In the areas of bronchopneumonia which may occur, polynuclear leucocytes are chiefly found, while the large pigmented cells take no part apparently in the active inflammatory process.

The vessels of the *kidneys* contain relatively few organisms. The glomeruli may be considerably pigmented. There may be marked degeneration of the epithelium of the capsules, and at times changes in the parenchyma, especially areas of necrosis of the epithelium of the convoluted tubules. The other viscera show no especially characteristic changes excepting at times the melanosis.

In the more *chronic forms of malaria* and in *malarial cachexia* the anæmia is usually particularly marked. The *spleen* is always enlarged and very firm. There is a marked thickening of the capsule, which is often adherent to the neighboring tissue. On section the spleen is generally of a dark brownish-gray color, the fibrous tissue throughout the organ being greatly thickened. The *liver* is considerably enlarged, and usually has a grayish-brown or slaty color. Microscopically, Kupfer's cells and the perivascular tissue may contain much pigment. At times there is a considerable increase in the connective tissue. The *kidneys* show no particular characteristic changes, though there may be considerable pigmentation; the pigment is most marked about the blood-vessels and the Malpighian bodies, and sometimes in the region of the convoluted tubules. There are no characteristic changes in the other organs, excepting the slaty-grayish pigmentation.

Symptoms.—As may be gleaned from what has already been said concerning the specific organisms, malarial fever occurs in several main types: (1) The milder intermittent fevers, which form the majority of all cases in the more temperate climates, and occur in the warmer climates more commonly in the spring and early summer: (*a*) Tertian intermittent fever and its combinations; (*b*) Quartan intermittent fever and its combinations. (2) The more irregular, æstivo-autumnal fevers, which usually show quotidian paroxysms.

Fig. 4.



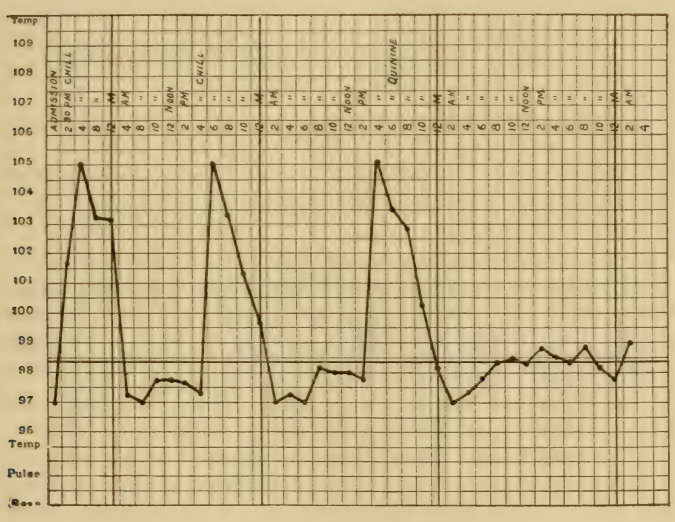
Tertian Fever.

Tertian Intermittent Fever.—This is by far the commonest form of malarial fever in this country, and with the quartan fever forms the mildest type of the disease. It is the type of the intermittent fever of the spring and early summer, though it may be seen at any time of year. It shows often no particular tendency to increase in severity, while in many instances, under proper care and change of climate, spontaneous recovery may occur. It depends, as we have seen, upon the invasion of the blood by an organism which passes through its cycle of existence in forty-eight hours. The febrile paroxysms occur when these parasites have reached their full development and begin segmentation. These periods occur with considerable regularity at intervals of forty-eight hours one from another. In older children the paroxysms may usually be divided into three stages: first, the *chill;* secondly, the *fever;* and thirdly, the *sweating.* The child, who may have been feeling fairly well beforehand, becomes suddenly uneasy, may begin to yawn, or may have an attack of vomiting or diarrhœa, which is followed or accompanied by a well-marked rigor, associated with cyanosis and coldness of the extremities. The temperature rises to a considerable height, possibly to 108° F. This stage lasts for a varying time, from ten minutes to an hour. As the chill ceases the patient passes into a stage in which there is marked flushing of the skin, with great heat and dryness. The child complains bitterly of thirst and headache, and is usually very fretful. There may be, as in the first stage, renewed attacks of vomiting or diarrhœa. This stage, after lasting for a vari-

able length of time, from half an hour to three or four hours, is followed by profuse sweating, the temperature falling within an hour or two to a normal or even a subnormal point. With the sweating the child may seem exhausted and weak, but shortly afterward appears again perfectly well.

Such an attack as this differs but little from the intermittent fever of adults, and indeed above the age of six the differences are very slight. Under this age, however, there are marked differences in the paroxysm. Very commonly in young children both the first and the third stages, those of the chill and sweating, are absent. The first stage is then generally represented by a slight restlessness, the face looks pinched, the eyes sunken, the finger-tips and toes may become cyanotic and cold, while the child may yawn or stretch itself. Oftentimes there is nausea or vomiting, and possibly diarrhœa. This may be the only manifestation of the first stage, though it may be followed by slight or severe nervous symptoms. These begin usually with a slight spasmodic twitching of the eyelids or of the extremities, and may go on to general convulsions. The chill in the adult is very often represented in the young child by the convulsion—a fact which is as true in all other acute febrile processes as in malarial fever. This stage lasts usually for a short time, not more than an hour or so. The temperature rises rapidly, possibly to 108° F.; then comes the period of fever, during which the child is much flushed, is restless, thirsty and fretful, while, as has been already said, various gastro-intestinal disturbances may occur. The fever remains at its height for an hour or two; afterward there is a gradual fall of temperature, unaccompanied by sweating. In many instances, besides the slight coldness of the hands and blueness

FIG. 5.



Double Tertian (quotidian fever).

of the finger-tips, and a somewhat pinched expression of the face in the first stage, the first and the third stages of the attack may be entirely lacking.

Pure tertian fever is rare in children, as the process is almost always a double infection; that is, the blood contains two sets of organisms, which attain maturity on alternate days, and give rise to *quotidian* paroxysms. If,

as is unusual, the case is one of pure tertian fever, the child may seem perfectly well on the day between the attacks.

Physical examination during the very first attack may reveal little or nothing, but usually by that time, and always after one or two paroxysms, an enlarged spleen may be made out. If a child has had more than two supposed malarial paroxysms and the spleen is not distinctly enlarged, we have almost sufficient evidence to put aside the diagnosis of malarial fever. Herpes labialis is a very common accompaniment. Anæmia is usually noticeable if the process has lasted for any length of time. The discovery of the specific organism in the blood is the one diagnostic point. The paroxysm in tertian malarial fever may last altogether from twelve to fifteen hours, though commonly it is much shorter, the first stage lasting from ten minutes to an hour, the second stage from an hour to three or four hours, and the third stage a varying length of time. As the length of time which the tertian organism requires to attain its full growth is almost exactly forty-eight hours, the attacks dependent upon one group of parasites occur almost regularly forty-eight hours apart, though in some instances we may find a tendency to anticipation or to retardation in the attacks. This point can only be determined by observation, so that one cannot definitely prophesy the hour at which an attack will occur until he has seen several paroxysms. It is easy to see that in the quotidian cases, which depend upon the presence of a double infection, the chills on the alternate days may occur at different hours, one group of organisms segmenting perhaps at ten o'clock, and the other at two. Usually, however, these differences are slight. Not infrequently we find the history of tertian attacks at first, and later on daily attacks of fever. The commonest time for the paroxysm in tertian fever is in the early part of the day, between eight in the morning and two in the afternoon, though they may occur at all hours either of the day or night. Irregularities in the course of the fever, no matter what the type may be, are much commoner in children than in adults.

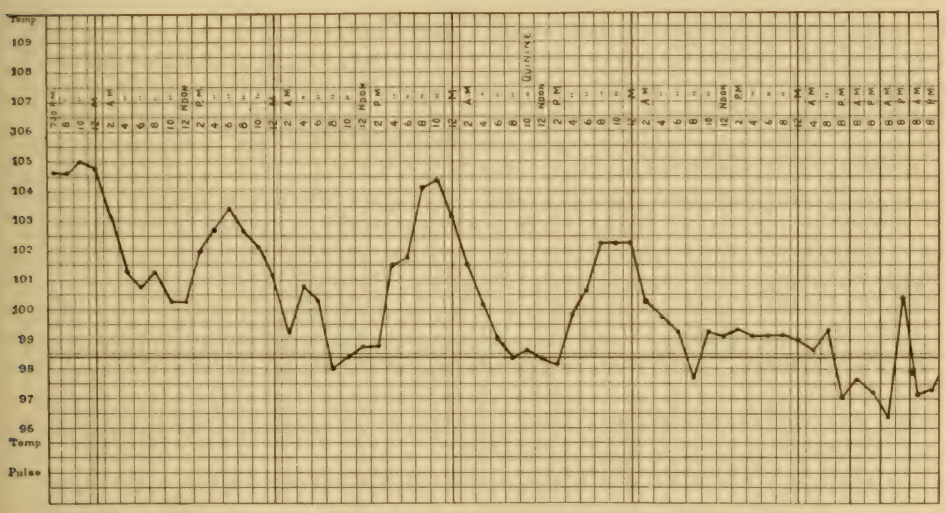
Quartan Fever.—This form of fever is rarely observed in this country. Out of about 500 cases of malaria treated at the Johns Hopkins Hospital in four years, it only occurred twice. Here the length of time required for the development of the organism is seventy-two hours, and the paroxysms occur every fourth day. The nature of the paroxysm does not differ from that observed in tertian fever. As one may easily see, complex attacks of fever may arise from a double or triple infection with quartan organisms. Thus we may have a daily paroxysm due to a quartan infection, or, on the other hand, paroxysms on two days in succession, with one day intermission, a triple or a double infection. The diagnosis of quartan fever may be made by a skilled observer from one examination of the blood by the discovery of the characteristic quartan organism.

The Æstivo-autumnal Fevers. "Tropical Malaria." "Febris Irregularis."—The malaria occurring in the late summer and fall is often of a much more severe type than that occurring in the spring, and, as has been shown by the Italian observers, most of these cases are due to a different type of the specific organism. It is in the later summer and fall that we see most of the cases of apparently irregular fever, and the so-called remittent malarial fever. The typical malarial cachexia, while it may follow any form of intermittent fever, usually results from this type of malaria. Most of the pernicious forms also come under this heading.

The So-called Irregular Remittent Fevers.—The recent Italian observers, asserting that there is in reality no actual irregularity, divide these

fevers into the quotidian, in which a daily paroxysm occurs, and the tertian, in which the paroxysm occurs on every other day; but in both instances there is a greater tendency to irregularity in the time required for the development of each brood of organisms. On the one hand, there is often a very marked tendency for the paroxysms to anticipate one another, or there may be a retardation, while again the attacks do not present themselves in so clean-cut and regular a form as in the spring fevers. They may be much lengthened out, so that one attack may follow another without the temperature ever actually reaching a normal point. Most of the cases of this type of fever seen

FIG. 6.



Æstivo-autumnal fever. (Quotidian.)

in this country show a distinct daily paroxysm; it is doubtful whether we see in America the "malignant tertian fever" of the Italians. The attacks may differ little from those in the ordinary tertian form, excepting that they are often more severe and of a somewhat longer duration, so that the afebrile periods are shorter or even absent. On the other hand, the onset may be very gradual, with daily exacerbations of temperature, accompanied by restlessness, flushing, often vomiting or diarrhœa, and headache, but without chills or perhaps even sweating. The attacks may be prolonged and run into one another, so that a remittent temperature results. There is often delirium or drowsiness and somnolence; the spleen is always enlarged. In this condition the diagnosis from typhoid fever or meningitis may be impossible without an examination of the blood. Such cases as this, however, do not generally go on to recovery without treatment, but tend to become pernicious, the paroxysms increasing in severity till death.

MALARIAL CACHEXIA.—The fever in some instances may never rise as high as it does in the paroxysms of tertian fever, nor may the immediate symptoms of the paroxysm be as striking, and the attention of the physician is often called to the patient for the first time when the stage of malarial cachexia has been reached. The child may then show a pitiful appearance. It is pale, of a sallow, parchment-like color, and often much emaciated. The skin is dry, the face has a drawn, pinched look, the eyes are sunken; there may be marked symptoms on the part of the digestive tract, frequent attacks of vomiting and

diarrhœa. The fever may stand in the background. Indeed, in some of these cases there may be for weeks relatively little fever. The spleen is always enlarged. Malarial cachexia does not exist in children without an enlarged spleen. In all instances, no matter whether our attention is called to the child on account of the fever or of the gastro-intestinal derangement, an examination of the blood will show the organisms, usually those characteristic of the æstivo-autumnal or tropical malarial fever, the small hyaline bodies, and the pigmented crescents and ovoid forms. Malarial cachexia may follow all forms of the disease, and not infrequently is seen in improperly treated cases of tertian fever or in those who have been subject to repeated attacks, but it is much more commonly seen in this type of fever.

Pernicious Malarial Fever.—It is in the æstivo-autumnal fevers that we see more commonly the pernicious forms of malaria, though these are rare in temperate climates. In these cases a previously healthy child may begin to show a slight restlessness, with a pinched expression of the face and some blueness of the extremities. An attack of vomiting or diarrhœa may occur, which may be followed suddenly by severe convulsions and a very rapid rise in temperature, which may be as high as 108°. The convulsions may continue or the child may pass into a dull, comatose condition, the pupils being fixed and possibly irregular; in this condition it may remain until death ensues. In some instances the whole attack may be represented by a condition of coma with collapse, possibly with little or no rise in temperature. These severe attacks are rare in this country, and it is not at all improbable that in regions in which severe malarial fever prevails many non-malarial attacks are ascribed to this disease. The definite diagnosis can only be made by the discovery of the parasite in the blood. Some of the most severe of these attacks are probably due to the infection with several groups of the organisms at once, so that segmentation is going on continuously.

Affections of Other Viscera sometimes Associated with Malarial Fever.—*Respiratory Apparatus.*—In all forms of malarial fever bronchitis is a common complication, as it is, indeed, with any acute febrile affection. This is particularly true in children. The appearance of a profuse coryza in the absence of the sweating stage has been noted.

Alimentary Tract.—In almost all cases of malarial fever in children symptoms are present on the part of the stomach and intestines. Vomiting in the first and second stages of the paroxysm is extremely common, while diarrhœas are also very frequently seen in all forms of malaria, particularly in the more remittent forms and in the chronic cachexia, where it is probably generally due to a secondary infection to which the debilitated child is more readily subject. Little is to be noticed on the part of the circulation.

Kidneys.—Slight albuminuria may often be observed, and in rare instances hæmaturia occurs. Malarial hæmaturia is generally considered a grave symptom. It is probably, however, a rare condition, except in districts where the severest forms of the disease are common. Many of the so-called malarial hæmaturias are due to other causes.

The literature of malarial fever contains numerous references to "malarial pneumonia," "malarial bronchitis," "malarial neuralgia," "malarial diarrhœas," and the like, most of which, in the light of our present knowledge, have probably little or no connection with malarial fever. It is easy to understand that the child debilitated by a severe malarial fever may more readily fall a victim to a variety of other diseases. In this way probably the gastro-intestinal and bronchial disturbances so commonly observed are to be explained. That there is any such thing, for instance, as a specific malarial

pneumonia is wholly out of the question. The chills which may occur sometimes with some regularity in the course of many of the specific fevers are commonly attributed to a malarious influence. These inferences are for the most part unjustifiable. In rare instances a patient who is subject to an acute or chronic malaria may develop typhoid fever at the same time, or the converse may occur, but these instances are few and far between, and the great majority of instances of chills occurring in typhoid fever have no connection whatever with malaria. Pneumonia may develop during the course of a malarial attack, but it is due in these cases to its specific cause. The examination of the blood is our one safe clue to the explanation of such complications.

Diagnosis.—*The Milder Tertian and Quotidian (double tertian) Fevers.*—The diagnosis of malarial fever in children may be made, in the first place, from the character and periodicity of the attacks; secondly, from the enlargement of the spleen, which is always present after the first or second attacks; and thirdly, by the presence of the malarial organism in the blood. In some instances there may be relatively few parasites, but the careful examination of several fresh specimens of the blood will always reveal the organism if present. Even in the absence of definite data with regard to the attacks, the diagnosis may be made by the type of organism found. The commonest type, as has been said, is the double tertian, *quotidian* fever.

The commonest condition with which malarial fever is confounded is tuberculosis in its various forms; the hectic evening temperature is often ascribed to malaria. Most pediatrists may, I fancy, remember more than one instance where after a diagnosis of malarial fever evidences of pulmonary, abdominal, or even glandular tuberculosis have developed. The absence of definite signs of tuberculosis, the splenic enlargement, and the anæmia, which may be marked, speak in favor of the malarial nature of the affection, while the absence of malarial organisms in several specimens of fresh blood, even in the presence of marked febrile paroxysms, is a sure sign of the absence of malarial fever.

The same rules of diagnosis apply to *quartan* fever. The characteristic organism of that type will be found on examining the blood.

Æstivo-autumnal Fevers.—It is the more irregular and remittent fevers and the malarial cachexiæ which give the most trouble to the diagnostician. The regularly intermittent fever may not here give us our clue to the diagnosis. On the other hand, the presence of a considerable anæmia in association with a markedly enlarged spleen, which is always present in this form of fever, will lead us to suspect the proper diagnosis, which will be confirmed by the discovery of the small ring-like hyaline intracellular organisms, and, if the case has lasted a week or more, the ovoid and crescentic pigmented bodies in the blood. This form of fever may often be confounded with tuberculosis. It may also simulate very closely, from the physical examination alone, leukæmia or the anæmia infantilis pseudo-leukæmica of Von Jaksch. In some instances where the paroxysms tend to run into one another and produce a more or less remittent fever, the differentiation of the process from fever may be impossible from the physical examination alone. The frequent herpes, the large size and prominence of the spleen, as well as the rapidly developing anæmia, may be suggestive, but here, as elsewhere, the examination of the blood alone gives us our certain diagnosis. In the absence of an examination of the blood, the chronic cachexiæ may be considered to be the result of the concomitant gastro-intestinal derangements or of the bronchitis, while in many instances the atrophy, the dyspepsia, and the diarrhœa may be found to depend upon the presence of the malarial organisms in the blood. In the cases of

severe pernicious malarial fever the examination of the blood is also our only safe clue to a diagnosis.

Methods of Examination of the Blood.—The examination is best made with fresh specimens. The lobe of the ear is punctured with a sharp, spear-pointed lancet; a very small cut is all that is necessary. This may be done behind the back without the child seeing the instrument, so that it may not be alarmed, while if the instrument is sharp the process is almost painless. In some instances it may be done while the child is asleep, without even awakening it. After wiping away the first drop or two of blood, a perfectly clean cover-glass is brought into contact with the tip of a small drop of blood, and allowed to fall immediately upon a freshly-cleaned slide. If the slide and cover-glass have been washed in alcohol just before using and are perfectly clean, the drop of blood will spread out regularly under the glass, and the corpuscles may be seen lying side by side free from crenation or any other artificial changes. Pressure on the cover-glass may spoil the specimen. It is best to hold the cover-glass in a forceps in order to avoid any injury to the corpuscles from the moisture of the hand. The specimen is then examined at best with a $\frac{1}{12}$ oil-emersion lens, and a 2, 3, or 4 eye-piece. A 4 eye-piece with an 8 objective, or a Zeiss E or F, will answer the purpose well, though an oil-emersion lens is clearer and better. In this manner all forms of the organism may be seen while yet alive. When it is impossible to examine the fresh specimen, dried and stained specimens may be used. A small drop of blood is taken upon one cover-glass, which is then allowed to fall upon the second glass. The drop immediately spreads out, and the two glasses are separated by being gently drawn apart. These specimens are allowed to dry in the air. They may be kept for almost any length of time before examining. There are numerous different methods for preparing and staining the specimen. As satisfactory a method as any is to place the glass in a solution of absolute alcohol and ether, equal quantities, for a half to one hour, or the specimens may be heated for from one to two hours at 100°–120° C. The specimen may then be stained in a concentrated aqueous solution of methylene blue for about a minute, washed in water, dried between filter-paper, mounted in balsam or oil, and examined. The red corpuscles remain unstained. Only the nuclei of the leucocytes, the malarial organisms, and occasional blood-platelets take up the blue coloring. In case a double stain is desired, one may make use of two solutions: Solution 1. Eosin 1 part; 70 per cent. alcohol 100 parts; Solution 2. Saturated aqueous solution of methylene blue. After preparing the specimen in absolute alcohol and ether as before, place it in Solution 1 for from fifteen seconds to half a minute, wash in water, dry between filter-paper; place it then in Solution 2, which has been diluted one-half with water, letting it stain for from one half to one minute; wash in water, and dry. By this method the red corpuscles and the eosinophilic granules in the leucocytes are stained red by the eosin, while the nuclei of the leucocytes and the malarial parasites are stained blue.

Good results may be obtained by Romanowsky's method: saturated aqueous solution of methylene blue, 1 part, 1 per cent. aqueous solution of eosin 2 parts. Do not shake or filter the mixture. Place the specimen (heated as above) in this mixture for two to three hours, and then in water for one to two hours, and dry. The parasites are stained blue. In this manner any practitioner who possesses a microscope may, without much labor, make the diagnosis of malarial fever. The examination of the fresh specimens will probably be found to be more satisfactory, and the observer who studies only stained specimens must beware of certain mistakes which one who is not familiar with the examination of

the blood may readily make, such as the confusion of the blood-plates, the hæmatoblasts of Hayem, with the malarial parasite—a mistake which certain good observers have recently made.

Course and Prognosis.—Excepting in the acute pernicious cases the prognosis in malarial fever is good, provided the case is recognized and properly treated.

If untreated the fever may take one of three courses:

(1) Mild cases may go on to spontaneous recovery;

(2) The paroxysms may gradually diminish in intensity, the fever becoming less marked, while grave anæmia develops, and the patient passes into the condition of chronic cachexia;

(3) The paroxysms may increase in severity, assuming finally a pernicious type.

Treatment.—*Prophylaxis.*—In a malarial district certain prophylactic measures should be taken with children as well as with adults. The child should be kept in the house after sundown and should be carefully kept away from those regions in which experience has shown that malaria is present. Sleeping on the ground floor of houses in malarious districts should be avoided.

Medicinally, we possess in quinine one of the few specific drugs which are at the command of the physician. In almost all cases of malarial fever we may expect with confidence a complete recovery after the use of quinine. There is only one form of malarial fever, and that rarely seen in this country, the acute pernicious malaria, in which we cannot entirely rely upon this drug. In the milder forms of the disease, the tertian and quartan fevers and their combinations, small doses of quinine are rapidly efficacious. One or two grains of quinine (.065–.13), three times a day in children under six years of age, will be followed by the rapid disappearance of all symptoms. The best time to administer a single larger dose of quinine is immediately after a paroxysm. In the more chronic and irregular forms, which are so apt to occur in the later summer or fall, the forms in which the smaller organisms are found, much longer treatment and larger doses of quinine may be required. Ordinarily, however, doses larger than two or three grains (0.13–0.2) three times a day are not required under five or six years of age. Relatively large doses of quinine may, however, be well borne, and in cases of pernicious malaria must be administered. Ferreiera states that he has given doses as large as 15 grains in infants under one year of age without noticing ill effects!

In pernicious cases the quinine must generally be administered hypodermatically. A good preparation is the muriate of quinine and urea. In ordinary cases it is probably better to give smaller doses several times a day than it is to give one large dose with the idea of "breaking up" the fever. In some children it is very difficult to administer quinine by the mouth, on account of the difficulty in disguising the taste, and because in some cases it is constantly vomited. In some cases in infants the drug is with difficulty retained. Here small doses should be given and often repeated. In these instances it may be administered by the rectum: the dose under these circumstances should be about double that by the mouth. The administration of quinine through the skin by means of ointments is probably of little value. In cases of the more chronic æstivo-autumnal forms of malaria, associated with crescent organisms in the blood, the treatment by quinine may have to be continued for a considerable length of time. The crescents may be found in the blood for months. The fever, however, if the case is truly one of malaria, will surely yield to the treatment after a few days. Much has been written about those

forms of malaria both in children and adults which do not yield to quinine. These cases are probably not true malarial fever, as examination of the blood will show. Few cases of fever in this country do not yield within a few days to treatment by quinine. By this it is not said that relapses may not occur; they are frequent in cases where the treatment has been continued too short a time. In some of the acute forms of fever, and more particularly in the more chronic forms and in the malarial cachexia, the anæmia and various gastro-intestinal disturbances may also demand our attention. In most instances, with proper attention to the diet, the gastro-intestinal symptoms will disappear after the disappearance of the fever. The anæmia, however, may require extended treatment with various preparations of iron, and even in the severe cases with arsenic, which is particularly well borne by children. The administration of arsenic, which is common in chronic malaria, has its chief value in its effect on the anæmia. Various other drugs have been tried in malarial fever, some of which have some influence on the attacks. The most important of these are preparations of eucalyptus and, of late, methylene blue. None, however, approach quinine in efficacy.

One attack of malarial fever does not, unfortunately, render the patient immune. On the other hand, he seems, if anything, to be more readily subject to fresh attacks, and in some instances these attacks may be so frequent and prolonged that a removal of the child to a proper climate is necessary.

RACHITIS.

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Rachitis is a constitutional disease, but its most conspicuous anatomical characters pertain to the osseous system. The gross nutritive changes which it produces in the bones and cartilages, causing deformities, are well known to physicians and the laity. In addition to these anatomical changes in the skeleton, typical cases exhibit a lack of tonicity with stretching of the ligaments, causing the knock-knee and flat-foot; weakness of the muscles, resembling paralysis and sometimes mistaken for it in severe cases; reflex irritability, rendering rachitic patients liable to laryngismus and tetany; undue perspiration; anæmia and proneness to catarrhal inflammation; and certain anatomical changes in the spleen and liver in aggravated forms of the disease. These many and divers anatomical and functional characters indicate the constitutional or general nature of rachitis. Therefore theories which restrict rachitis to the osseous system are inadequate and erroneous.

Rachitis is probably an ancient disease. It is said that an old statue of Æsop, who was thrown from a precipice by the indignant Delphians 564 years before Christ, exhibited rachitic deformities; and Hippocrates, born 460 years before Christ, is believed to have alluded to it in his treatise on the Articulations.

Occasionally expressions in the works of Celsus and Galen in the second century of the Christian era have led writers on rickets to believe that they also had observed the deformities produced by this disease. But rickets was first investigated in a scientific manner by Whistler, Glisson, and their contemporaries in the middle of the seventeenth century. During the last few years many excellent monographs have been written on this malady, and its causation, pathology, and treatment are better understood than formerly.

Frequency.—Rachitis is a widespread disease, but it is comparatively infrequent in rural localities, where families enjoy the hygienic requirements of pure air, sunlight, and a plentiful diet of good quality. It is most common in crowded and badly-fed families in city tenement-houses, where antihygienic conditions prevail.

Mild cases of rickets, not manifested by any prominent signs or symptoms, are often overlooked, so that the physician is not summoned, or, if he be summoned and have not given particular attention to this disease, he, in not a few instances, does not detect its presence. In the absence of deformity, which occurs later, the fretfulness, tenderness of surface, and perspirations are likely to be attributed to other causes than the correct one. Hence, according to my observations, rachitis is more common in its milder forms in the asylums and dispensaries and in the tenement-houses of New York, and probably in other American cities, than is commonly believed by the laity, and even by physicians who have given little attention to the disease. A few years since in one

of the New York asylums my attention was directed to a rachitic child in whom the anatomical characters of rachitis had become so pronounced that they attracted the attention of the nurses. Prompted by the occurrence of this case, which had developed during my attendance in the asylum, I made an examination of all the infants, and found, what I had previously not suspected, that about one in nine presented unmistakable signs of rachitis, though in a mild form and for the most part in its commencement. The late Dr. John S. Parry of Philadelphia stated that at least 28 per cent. of the children between the ages of one month and five years who came under his observation in the Philadelphia Hospital, during the three years preceding the publication of his paper in 1872, were rachitic. According to Dr. Gee, whose observations were, however, made as far back as 1867 and 1868, of the patients under the age of two years in the London Hospital for Sick Children, 30.3 per cent. were rachitic; and Ritter von Rittershain, whose observations were also made several years ago, stated that of 1623 out-door patients under the age of five years brought to the Clinique at Prague, 504, or 31.1 per cent., manifested this disease. Recently Prof. Henoch of the University of Berlin has stated that he had seen many thousand cases of rachitis, and he adds that its spread in the large cities of Northern and Middle Europe is enormous. He states that his observations in regard to the frequency of rachitis in dispensary practice correspond with those of Ritter, as many as 31 per cent. being rachitic. In Manchester also, with its large number of operatives, Ritchie's statistics show that of 728 out-door patients 219 were rachitic. The curator of the New York Foundling Asylum for the last ten years informs me that he believes, without the accuracy of statistics, that as many as 20 per cent of the cadavers examined by him in the dead-house have presented the anatomical characters of rachitis, usually in a mild form.

The recent large emigration from Europe of destitute families, living from choice or necessity in filth and degradation, who for the most part remain in the cities, occupy small, dark, and dirty apartments, and whose food is of the poorest quality and often insufficient, greatly increases the number of rachitic children in New York and probably in other American cities. In the out-door department of Bellevue, to which many thousand immigrants from the lowest class of European society carry their sick children for treatment, rachitis is not infrequent; and the fact has been observed in this institution that a larger proportion of severe cases attended by marked deformities occur in the Italian families than in those from other parts of Europe. In families of American parentage it is generally admitted that rachitis is more prevalent in the negro than in the white race.

Although this disease occurs most frequently in the families of the destitute and poorly fed, nevertheless children of well-to-do families occasionally suffer from it, even in an aggravated form, in consequence, I think, usually of ignorance on the part of parents in regard to the dietetic requirements of young children. Merei, in his treatise on the Disorders of Infantile Development (London, 1850), states that in Manchester, where his observations were made, one child in every five in comfortable circumstances presented rachitic symptoms. In the United States rachitis is rare in well-to-do families, who provide sufficient and suitable diet for their children and have a proper regard for sanitary requirements. When it does occur in such, it is due usually, I think, to improper feeding. But this cause will be discussed in another place.

Diagnosis.—In preparing statistics relating to rachitis it is obviously important that the diagnosis of mild and incipient cases should be clear and unmistakable. What symptoms and anatomical characters indicate rachitis?

The fact that an infant has reached its ninth month without a tooth is regarded by Sir William Jenner as a reliable sign of rachitis. In order to determine to what extent dentition is retarded by rachitis—and retarded dentition may be considered a sign of rachitis—Dr. H. R. Purdy, physician to the Out-door Department of Bellevue Hospital, made the following observations:

TABLE I.—*Showing at what Age 200 Infants exhibiting no Signs of Rachitis cut the First Tooth—cases consecutive.*

3	cut	first	tooth	at	2	months.			
14	"	"	"	"	3	"			
16	"	"	"	"	4	"			
20	"	"	"	"	5	"			
24	"	"	"	"	6	"			
37	"	"	"	"	7	"			
28	cut	first	tooth	at	8	months.			
20	"	"	"	"	9	"			
14	"	"	"	"	10	"			
15	"	"	"	"	11	"			
8	"	"	"	"	12	"			
1	"	"	"	"	13	"			

Of these, 132 were wet-nursed, 68 bottle-fed.

TABLE II.—*Showing at what Age 50 Infants exhibiting one or more Rachitic Symptoms cut the First Tooth—cases consecutive* (18 wet-nursed, 32 bottle-fed).

2	cut	first	tooth	at	4	months.			
2	"	"	"	"	5	"			
3	"	"	"	"	6	"			
2	"	"	"	"	7	"			
5	"	"	"	"	8	"			
6	"	"	"	"	9	"			
7	cut	first	tooth	at	11	months.			
5	"	"	"	"	12	"			
6	"	"	"	"	13	"			
3	"	"	"	"	14	"			
1	"	"	"	"	16	"			
1	"	"	"	"	18	"			

TABLE III.—*Thirty Infants without Teeth, but with pronounced Rachitic Symptoms.* (In all these cases the rachitic rosary, enlarged subcutaneous veins, profuse perspirations, abdominal distention, and enlarged joints were present. Bottle-fed, 21; wet-nursed, 9. Age at which they cut the first tooth.)

6	at	7	months.						
10	"	8	"						
1	"	9	"						
1	"	10	"						
4	"	11	"						
3	at	12	months.						
2	"	13	"						
2	"	14	"						
1	"	15	"						

It is evident from these interesting statistics that dentition delayed until the ninth, or even the tenth or eleventh month, is not a certain sign of rachitis, but slow teething is common in the rachitic, and therefore it aids in the diagnosis. It is one of the diagnostic signs.

In order to determine whether rachitis incipient or of a mild form be present, all the signs which characterize it should be considered—the fretfulness, free perspiration upon the head, neck, face, and chest, the tenderness of surface, anæmia and general deterioration of health, delayed dentition, swelling of the joints, craniotabes, bending of the long bones, rachitic rosary, misshapen head, prominent frontal and parietal bones, deformity of the thorax with depression of the ribs, projecting or misshapen sternum and prominent abdomen, with Harrison's groove. All these signs and symptoms must be considered before making a diagnosis in incipient or mild rachitis. In order to determine the diagnostic value of enlargement of the costo-chondral articulations, "the rachitic rosary," in three of the New York institutions I have examined these joints in children supposed to be healthy or suffering from other ailments than

rachitis. In many young children believed to be healthy these joints are not appreciable on palpation. In others a slight prominence can be felt in one or more joints. In order that the beading of these articulations be sufficient to indicate rachitis, it should, I think, be plainly detected by the fingers in most of these articulations. Less than this I would not regard as sufficient evidence of this disease.

Age of Occurrence.—Rachitis is, with few exceptions, a disease of infancy. A large majority of the cases occur before the age of three years. Now and then it occurs in the fœtus, producing deformities such as are present in typical cases. In the Kinderspital Museum at Prague is a specimen of fœtal rachitis described by Ritter. Hink and Winkler also relate fœtal cases, and Virchow alludes to a specimen in the Würzburg Museum which exhibits such deformities as characterize rachitis. Bednar even regards fœtal rachitis as not uncommon (Hillier, Parry). In the Wood Museum of Bellevue Hospital is a skeleton which is probably similar to those in the Prague and Würzburg museums. It shows in a striking manner the deformities of congenital rachitis. The case occurred in my practice, and the dissection was made by Prof. Francis Delafield. The infant, born at term, died a few hours after birth from atelectasis, apparently produced by the lateral depression of the ribs and contracted state of the thorax. The parents were hard-working English people, whose mode of life and surroundings were such as are known to conduce to rachitis. They were free from syphilitic taint. The accompanying wood-cut represents this skeleton.

The following remarkable case of supposed fœtal rachitis was related to me by Dr. Heitzmann, whose interesting experiments will presently be detailed:

A woman who had frequently inhaled the vapor of lactic acid each day for many months, as she was employed to feed animals with this agent, gave birth to an infant at term which died immediately after it was born. It exhibited the signs of congenital rachitis in a high degree. The skull-bones were completely absent; in the cartilages of the bones of the extremities and in those of the ribs there were scanty depositions of lime salts and numerous infarctions. The death of the child was evidently due to the absence of the skull-bones, inasmuch as the pressure upon the head occurring during birth had caused cerebral hæmorrhage. The organs of the chest and abdomen were fully developed and normal. In the *New York Journal of Obstetrics* for Nov., 1870, Dr. A. Jacobi also published the description of a case of congenital rachitic craniotabes.

Fig. 1.



Congenital Rachitis.

Enlargement of the costo-chondral articulations, known as the rachitic rosary, has been observed, though rarely, in infants only a few weeks old. Dr. Parry saw it as early as the sixth week after birth, and Dr. Lee at the third or fourth week. The significance of this enlargement as a sign of rachitis we have treated of elsewhere. We have stated that with few exceptions rachitis begins before the close of the third year. Though first detected and diagnosticated at a later date, it will ordinarily be ascertained, on inquiry, that its symptoms had an earlier beginning. Still, according to certain observers, it may have a considerably later commencement. Glisson, Portal, and Tripier state that they have seen it commence in children who were well on toward the age of puberty. Sir William Jenner says that he has seen children of seven and eight years who were only beginning to suffer from rachitis.

The following are the aggregate statistics of Bruennische, Von Rittershain, and Ritsche relating to the age at which rachitis occurs:

	No. of Cases.
During the first half year	99
" " second half of first year	259
" " " year	342
" " " third year	134
" " " fourth year	31
" " " fifth year	17
Between the fifth and ninth years	21
Aggregate	903

Etiology. — *Inheritance.* — Some patients with rachitis appear to have inherited a predisposition to it. Feeble digestion and defective assimilation in the infant—which are, as we will see, important factors in producing the rachitic state—are often traceable to disease or cachexia of one or both parents. Among the parental causes may be mentioned poverty, hardships, and defective nutrition of either parent; age of father and exhausting discharges of the mother, such as purulent, hæmorrhoidal, or uterine fluxes. The offspring of a tubercular, syphilitic, or otherwise enfeebled parent is more likely to become rachitic than is one of healthy and robust ancestry. We will especially emphasize the syphilitic dyscrasia in either parent as a potent cause, but M. T. Parrot, in his thesis published in 1872, evidently went too far in attempting to show that congenital syphilis is the common cause of rachitis. Most rachitic cases are entirely free from the syphilitic taint, and a large proportion of the children who have inherited the syphilitic dyscrasia do not exhibit any signs of rachitis.

Antihygienic Conditions. — In the damp, dark, filthy, and overcrowded tenement-houses of the city, rickets occurs most frequently and in its severest forms. There can be no doubt that general mal-hygiene is a potent factor in causing this disease, and that it sometimes produces it in those who have inherited good constitutions. On the other hand, many children with healthy parentage and vigorous at birth, reduced by poverty to a life of squalor and privation, do not become rachitic.

Food.—Of the antihygienic conditions which give rise to rachitis, the most common and potent appears to be the use of food not sufficiently nutritious, or, if nutritious, not suited to the age and digestive powers of the child. The use of thin and poor breast-milk and artificial food of poor quality or not suitable for the stage of growth and development is a common cause of rachitis. Those children who have been prematurely weaned, and who have been given a food which is not a proper substitute for the natural aliment, and those too long wet-nursed by scantily-fed and poorly-nourished mothers, and not allowed the additional aliment which they require, are especially liable to this disease. Those children whose digestive power is feeble, from whatever cause, are more likely to become rachitic than those who in a state of robust health have a hearty digestion. Hence we meet with rickets as a sequel of various protracted and exhausting maladies during infancy.

I might relate cases of rachitis occurring during the use of certain of the popular proprietary or commercial foods. I have examined the analyses of these foods made by Prof. Leeds in order to determine what ingredient is lacking, and they are found to contain a considerably smaller percentage of fat than occurs in human milk. Too little fat in the food may, as Cheadle observes, be one of the chief dietetic causes of rachitis. Infants suckled by healthy mothers or wet-nurses who have an abundance of milk, of good quality, do not become rachitic as long as their nutriment is derived from this source. But

those prematurely weaned and given a diet deficient in nutritive properties, and those who are allowed the promiscuous food of the table or have largely a farinaceous diet during the first and second years, when the food should be chiefly milk, are especially liable to become rachitic.

It is an interesting fact, and one that throws light on the dietetic cause of rachitis, that it does not occur in Japan. Physicians who have had abundant opportunities to observe the diseases of the Japanese state that they have never seen or heard of a case among them. M. Remy, in his *Notes Médicales sur le Japon*, says that the Japanese women have a remarkable abundance of milk, and that they suckle their young until the age of five or six years, but their children are also given artificial food after the first year. Remy's explanation of the immunity of the Japanese from rachitis is as follows: "The Japanese have always eaten plentifully of fats and oil of fishes, the blubber of the whale, the eel and loach especially. . . . . The universal use of the food under notice from the time of ancient Buddhist flesh-prohibition, but especially the consumption of fish by the lactating women, together with the fish given to the children as supplementary feeding, which at that time is allowed them by Japanese tradition, are, in my opinion, main causes of the non-existence of rachitis in Japan."

Observations on the feeding of animals have also aided in the elucidation of the causation of rachitis. Guérin gave certain puppies a diet of meat four or five months, and they became markedly rachitic, while other puppies of the same litter, suckled by their mother, remained well. At a meeting of the section of Diseases of Children of the British Medical Association, held in August, 1888, Dr. W. B. Cheadle read an instructive paper on rachitis, in which he said that the results of feeding young animals in the Zoological Gardens strongly support the view that a deficiency of animal fats and earthy salts are the most efficient agents in producing rickets. He states that in the Zoological Gardens the young monkeys taken from their mothers and fed with a vegetable diet, chiefly fruits, became rachitic. Such diet is destitute of animal fat, and is deficient in proteids and earthy salts. Two young bears were fed with rice biscuits, and occasionally with lean meat, which they licked, but rarely ate. Fat, proteids, and lime salts were practically excluded from their food. The bears died of extreme rickets while still young. Cheadle also states that more than twenty litters of lions had died successively of rachitis, and the next brood were fed with cod-liver oil, pulverized bones, and milk. In three months all signs of rickets had disappeared. The addition of fat and bone-salts caused the change, and after eighteen months, when the last observations were made, the brood of young lions were strong and healthy. They had received in every respect the same treatment as the litters that had perished, except as regards the diet. The latter had been fed with the carcasses of old horses, which are destitute of fat and whose bones resisted the lions' teeth.

The theory that lactic acid is the causal agent in rachitis has been strongly advocated by Dr. C. Heitzmann, formerly of Vienna, but now of New York. He administered lactic acid by mouth and subcutaneous injection to five dogs, seven cats, two rabbits, and one squirrel. The lactic acid administered to the dogs and cats, with "restricted administration of calcareous food," produced the characteristic enlargement of the epiphyses, and finally the "curvatures of the bones of the extremities." After four or five months of administration of lactic acid the long bones were very flexible, and repeated inflammations of the conjunctiva, bronchi, stomach, and intestines had occurred.

But in many cases of rachitis there is no evidence of an excess of lactic acid, and an objection to the lactic-acid theory apparently valid is that lactic

acid, produced by imperfect digestion, would unite with a base, either the soda or potash in the blood, which is always alkaline, before it reached the osseous system. The more the causation of rachitis is elucidated by observations on man and experiments on animals, the stronger is the evidence that its chief cause is dietetic—that there is a failure to receive or to digest and assimilate certain important substances in the food, particularly the fat, phosphate of lime, and proteids. The deprivation of these alimentary substances produces the rachitic dyscrasia, which is manifested by malnutrition in many tissues. Of course general antihygienic conditions, which lower the vitality, may, as we have stated elsewhere, be a factor in causing rachitis.

Pathology.—Distinguished pathologists and clinical observers who have investigated rachitis, and whose investigations have been chiefly, if not entirely, restricted to the osseous system, have regarded this disease as an inflammation affecting the bones and cartilages. Among those who have expressed this opinion may be mentioned Virchow and Niemeyer. Niemeyer says: "It seems to me that the most probable hypothesis regarding the cause of rachitis is that which refers it to inflammation of the epiphyseal cartilages and periosteum." The increased vascularity of the periosteum, the proliferation of periosteum and cartilage, the tenderness and pain on motion, and the elevation of temperature in acute forms of the disease, indicate inflammation rather than any other recognized pathological state. If the rachitic disease of the osseous system be regarded as an inflammation, it obviously presents a subacute or chronic character, like cirrhosis and certain forms of chronic nephritis, in which proliferation of connective tissue and sclerosis occur. The eburnation, instead of normal ossification, which terminates the rachitic process, might be considered an osteosclerosis. Moreover, the thickening, hyperæmia, and infiltration of the periosteum, exudation and formation of new vessels in the periosteum and underlying cartilaginous and osseous tissues, are conformable with the theory of the inflammatory nature of rachitis. On the other hand, some of the structural changes in the soft tissues in rachitis which are described in this paper are not such as ordinarily result from inflammatory processes. Billroth, seeing the difficulties in the way of the inflammatory theory, wrote of rachitis that it "cannot be exactly classed among the chronic inflammations, although nearest related to this process." It seems most in consonance with the facts to regard rachitis as a constitutional or general disease, a dyscrasia affecting the nutrition of various tissues of the body, and producing disease in the osseous system which is either inflammatory or closely allied to inflammation.

Changes in the Soft Tissues.—We have stated that although the conspicuous lesions of rachitis pertain to the skeleton, the soft tissues are also more or less implicated, as might be expected, since the disease is systemic in its nature. The skin in mild cases is but little involved, but as a rule the perspiration of the rachitic is excessive from the head, face, neck, and chest. This may occur before changes are observed in the skeleton. Pyrexia is in some patients absent or slight, but catarrhs of the mucous surfaces are common, and these are likely to give rise to some elevation of temperature. The fever that frequently accompanies severe cases may sometimes result from the disease of the skeleton. In protracted and severe cases the patients become markedly anæmic, but in recent and mild cases the pallor may be so slight as not to attract attention. Emaciation is not pronounced, as a rule, in the rachitic, but in certain patients the muscles throughout the system become shrunken and flabby, partly perhaps in consequence of the gastro-intestinal disorder, indigestion, and malnutrition, partly perhaps from want of use, for the rachitic are likely to be passive.

Mucous Membranes.—Rachitis, as we have stated above, increases the liability to catarrh of the mucous surfaces. Writers on this disease have remarked the frequent occurrence of bronchitis, broncho-pneumonia, entero-colitis, and conjunctivitis.

Ligaments.—The ligaments become relaxed and flabby, giving unusual mobility to the joints and unsteadiness to the movements. The fibrous bands which unite the vertebræ, as well as the ligaments of the extremities, participate in the relaxation. Talipes valgus and knock-knee are especially likely to occur in rickets as a result of the relaxation of ligaments, even when the bones are but slightly involved. Kyphosis, lordosis, and scoliosis—backward, forward, and lateral curvatures of the spine—also result from relaxation of the ligaments, aided by the softening and change in shape of vertebræ and of the intervertebral cartilages.

The Spleen and Liver.—The spleen is sometimes enlarged, as ascertained by palpation and percussion. Ritter von Rittershain found this organ decidedly enlarged in 10 out of 35 cases which he examined after death. The enlargement is the result of cellular proliferation, common in diseases which are attended by a dyscrasia. In a recent very anæmic and fatal case of rachitis in the New York Foundling Asylum the spleen extended below the level of the umbilicus. But in many cases of rachitis, even when profound, splenic enlargement is slight or is not appreciable.

The liver in many patients undergoes no perceptible change, except that it is carried downward by the lateral depression of the ribs. It is occasionally enlarged from fatty infiltration, but no special significance attaches to this, for fatty liver is common in various forms of disease attended by innutrition and wasting. It is common in tuberculosis and in protracted intestinal catarrh, and its pathological significance appears to be the same in these various diseases. There can be no doubt that Sir William Jenner errs when he states that albuminoid infiltration of the liver is common in rachitis. Parry, Gee, Dickinson, and Senator agree that it is rare, and that when it does occur it is a coincidence.

In the discussion of rickets at the meeting of the British Medical Association in August, 1888, Dr. Ranke of Munich said that, according to the records of 34 post-mortem examinations of rachitic cases in Virchow's Pathological Institute between 1872 and 1880, 13 exhibited changes in the liver, mostly parenchymatous fatty infiltration with increase of volume. In the 34 cases the spleen was recorded enlarged in 9 and small in 2. In the remaining 23 cases the size and appearance of the spleen were probably normal, or some mention would have been made of it. Dr. Ranke also consulted the records of the Munich Pathological Institute under Professor Bollinger, and in 9 of 25 post-mortem examinations of rachitic cases more or less enlargement of the liver was recorded. We may therefore infer from these carefully conducted examinations that enlargement and structural changes of the liver and spleen only occasionally occur in rachitis—that in the majority of cases this disease runs its course without any notable alteration in these organs. My own observations lead me to believe that hypertrophy of the spleen, and probably also of the liver, occurs chiefly in decidedly anæmic subjects.

The Abdomen is Protuberant from various causes. The lateral depression of the thoracic walls causes the liver and spleen to descend a little lower in the abdominal cavity than natural, producing at the base of the chest anteriorly Harrison's groove, which is transverse and corresponds with the insertion of the diaphragm. The enlargement of the liver and spleen, the feeble tonicity of the intestinal muscular fibres, and consequent distention of the intestines with gas, and the rachitic shortening of the spinal column,

which causes approximation of the ribs and pelvis, necessarily produce abdominal protuberance.

The Kidneys and Urine.—Observations thus far have not detected any structural change or disease of the kidneys attributable to rachitis, except that this organ is enlarged in some cases. Moreover, the records of the urine are so conflicting that more exact and more numerous examinations of this excretion are required before any positive statement can be made in reference to its composition. Dr. C. H. Flagge has seen two cases in which there were large quantities of uric acid in the urine. Ephraim also mentions an increased elimination of uric acid up to 18 per cent. Ephraim likewise, as well as Marchand and Lehmann, state that there is an increase of phosphate of lime and the occurrence of lactic acid in the urine.

Brain and Spinal Cord.—It is not improbable that the symptoms of rachitis which are referable to the nervous system, such as laryngismus stridulus, tetany, convulsions, and weakness or paralysis of the extremities, may be largely due to the pressure exerted in places upon the cerebro-spinal axis by its bony covering. Hence we will postpone their consideration until we have described the changes produced by rachitis in the osseous system.

Changes in the Osseous System.—A knowledge of the normal anatomy and normal development of the osseous system will enable us to better understand the changes which occur in this system in disease, and especially, which concerns us at present, in rachitis. Hence we will give a brief résumé of the anatomy of the skeleton in health before we consider the changes produced in it by rachitis.

Osseous System in Health.—In health and when fully developed, bone consists of animal matter (chiefly gelatin) and earthy salts, in the proportion, by weight, of about one part of the former to two of the latter. The following is the analysis, which may be regarded as approximately correct, of healthy human bone of the adult:

	Animal matter	33.30
Earthy salts.	Tribasic phosphate of calcium	51.04
	Carbonate of calcium	11.30
	Fluoride of calcium	2.00
	Phosphate of magnesium	1.16
	Soda and chloride of sodium	1.20
		100.00

In childhood the bones are softer, more elastic, and less likely to fracture than in the adult. Of the earthy salts in bone, it is seen that the phosphate of calcium is the most abundant, and it is the most important. Hence it is termed "bone earth." The phosphate of calcium, combined with animal matter, produces a hard compound. The enamel of the tooth consists chiefly of phosphate of calcium (88½ per cent.), while the softer egg-shell consists chiefly of the carbonate of calcium. The strength of bone is remarkable, being, according to Holden, when compared with wood, nearly three times that of the elm or ash, and double that of the oak. It is elastic on account of the animal matter which it contains. If a long bone be placed at right angles upon a hard substance, and the projecting end receive a blow from a hammer, the latter will rebound. The Arab children are said to make bows of the camel's ribs.

If a longitudinal section be made through a long bone, we observe a hard or compact outer part, and in the interior the medullary canal, containing marrow. In birds of flight the hollow of the bones contains air instead of marrow, and this air communicates with the lungs.

The hard or compact portion of bone, though solid like a stone, consists of layers in close apposition, so that there is no interval between them. On approaching the joints the internal layers of the compact structure separate from each other, forming the cancellous tissue, so that the compact wall becomes thinner. If the earthy salts be removed by an acid, the animal matter remaining is found to consist of layers, which can be separated from each other. In inflammation the afflux of blood and the exudation cause separation of the layers and enlargement of the bone.

The cancellous tissue occupies the interior of the bone, and is most abundant in its articular ends. The bony layers in the cancellous structure are separated from each other, so as to form cavities, which are strengthened by cross-plates like latticework. In the adult the marrow in the interior of the shafts of the long bones is yellow, consisting of 96 per cent. of fat, but in the articular ends of the long bones, in the ribs, cranial bones, and short bones, the marrow has a reddish tinge, and it consists of about 75 per cent. of water and about 25 per cent. of albumin, without fat or only a trace of it. This kind of marrow occurs in all the bones of the fœtus and the infant, and it contains cells with many nuclei, designated "myeloid cells." Holden says that bones are as minutely provided with blood-vessels and nerves as are the soft tissues. Near the extremities of the long bones are numerous minute openings through which blood is conveyed to and from the cancellous tissue. On the shafts of the long bones are slight grooves parallel with the shafts, at the bottom of which are minute holes, scarcely visible, through which blood is conveyed to and from the compact tissue. The blood which supplies the osseous tissue is conveyed through these holes by minute arteries from the vessels of the periosteum, and is returned by veins to the periosteum. Near the middle of the shaft of the long bone is a distinct canal passing obliquely through the shaft. This canal contains the nutrient artery of the medulla, dividing, after entering the medullary cavity, into two branches, one passing upward and the other downward. The blood-vessels supplying the different parts of the bone from these various sources intercommunicate. Other bones than the long bones are supplied with blood in a similar manner, and the nutrient vessels are accompanied by nerves, as in other parts of the system.

The microscope is required in order to reveal the minute anatomy of bone. It is found to consist of canals, termed the Haversian, and around each canal the bone is arranged in concentric layers, like the concentric rings of a tree. Between the rings are dark spots, designated lacunæ, arranged concentrically, now known to be minute reservoirs containing blood. Minute lines are seen connecting the reservoirs with each other and with the adjacent Haversian canal. The lines are minute blood-vessels, and through them the blood is conveyed to every part of the bone. They are designated canaliculi. They connect externally with the vessels of the periosteum, and internally with the vessels of the medullary membrane or endosteum. In the interspaces between the lacunæ and canaliculi, in the animal matter, an infinite number of osseous granules is deposited, consisting mainly of phosphate and carbonate of lime.

Alterations in the Osseous System in Rachitis.—For convenience of description the course of rachitis as regards the osseous system is divided into three periods: (1) That of proliferation and altered nutrition of cartilage and periosteum; (2) That of curvature and deformity; (3) That of reconstruction.

1. **Anatomical Characters in the Stage of Proliferation and Altered Nutrition.**—The long bones in normal growth increase in length by the formation of bone in the cartilage between the diaphysis and epiphysis, and

in thickness by the development of bone from the vascular and cellular under-surface of the periosteum. As regards the flat and short bones, growth in the thickness occurs from the periosteum, and growth in breadth occurs from the development and ossification of the cartilaginous borders and edges, which correspond with the epiphyseal cartilage of the long bones.

If we examine the epiphyseal cartilage of a long bone during normal ossification, we observe, beginning at the distal end, a white zone, consisting of the hyaline matrix, in which are the usual cartilage-cells. This constitutes most of the cartilage. Underneath this, and nearer the bone, is the zone of proliferation, the cartilage in which is softer and more yielding than that of the distal zone, in consequence of cell-formation and absorption of the matrix to make way for cell-groups. Each cell in the proliferating zone has divided into two cells, and each of these cells into two other cells; and the division has been repeated, so that eight cells instead of one are observed, surrounded by a common capsule. The capsule becomes distended by the cell-multiplication and the swelling of each cell, the size of which is considerably greater than that of the parent cell. Near the bone, along the extremity of the diaphysis, the cell-groups, enclosed in their capsules, nearly touch each other, the matrix having been for the most part absorbed. The end of the diaphysis is covered with a layer of these cell-groups about to undergo ossification, with almost no intervening matrix. The proliferating zone has very little depth. It appears to the naked eye as a very thin, scarcely perceptible layer of a reddish-gray color upon the end of the shaft. It is so thin that it but slightly increases the thickness of the cartilage.

In rachitis the state is different. The zone of proliferation, instead of being confined to a single or at most double layer of cell-groups, consists of many layers, involving nearly the whole epiphyseal cartilage. The cells, still enclosed in their capsules, undergo a more frequent division than in health, so that, instead of groups of eight cells, as in the normal state, each group consists of thirty or forty cells enclosed in the distended capsule. Therefore in rachitis the proliferating cartilaginous zone is a broad cushion, very soft, of a grayish translucent appearance, causing the characteristic swelling observed around the joint. Over the distal end of the proliferating cartilage there may still be a zone, though perhaps of little depth, of normal cartilage like that in health.

While the changes described above occur in the cartilages, the ossifying process is arrested or rendered abnormal. We indeed perceive an effort in the direction of bone-formation. The Haversian canals, surrounded by capillary loops, extend from the bone into the proliferating zone of cartilage. Their extension is effected by absorption of the matrix and appropriation of cell-groups which lie in their way. The cells in these groups, as they enter the Haversian system, become much smaller by rapid segmentation, forming medullary cells. We also find, as further evidence of the attempt at bone-formation, granules and masses of lime scattered through the cartilage, and here and there spiculæ and nodules of true bone springing up from the bony substance of the shaft. Some of the canals are prolonged far into the cartilage—nearly, indeed, to its free surface—but most of them terminate in its lowest portions.

We have stated that the growth of bone in thickness occurs from the under surface of the periosteum. In health a soft, vascular germinal tissue springs from the periosteal surface, rapidly receives lime salts, and is transformed into bone. This germinal tissue, consisting largely of capillaries rising from the fibrous tissue of the periosteum, is a very thin substance, barely visible, transient, and constantly changing from its conversion into bone.

In rachitis this vascular subperiosteal tissue, not undergoing, or undergoing slowly and imperfectly, the osseous transformation, and at the same time increasing more rapidly than in health under the irritating influence of the rachitic disease, becomes a thick layer. Its color and appearance are like spleen-pulp, so that the older observers supposed that there was hæmorrhagic extravasation between the periosteum and the bone. There is, however, no extravasation of blood, unless it accidentally occurs from the numerous delicate capillaries. The resemblance to extravasated blood or spleen-pulp is due to the abundant growth of large and thin-walled capillaries from the under surface of the periosteum, as shown by the microscope. This vascular outgrowth is, for the most part, quite uniform over the shafts of the long bones, while upon the cranial bones its thickness is much greater in one locality than in another. The attempt at ossification also appears in this tissue. Lime salts are scantily and loosely deposited through it, forming osteophytes, vascular and fragile, rather than true bone. The question naturally arises, How does rachitis affect bone which is already formed when the rachitic state begins? Virchow's answer is the following: "Rachitis has by more accurate investigation been shown to consist, not in a process of softening in the old bone, as it has previously been considered to be, but in a non-consolidation of the fresh layers as they form: the old layers being consumed by the normally progressive formation of medullary cavities, and the new remaining soft, the bone becomes brittle."

We have seen that in healthy bone the earthy salts are in excess of organic matter nearly in the proportion of two to one, but in rachitis the proportion is reversed, the organic matter being much in excess. The following table gives analyses of rachitic bones by Marchand, Davy, Boettger, and Friedleben:

	Femur.		Radius.		Vertebra.	
	Inorganic.	Organic.	Inorganic.	Organic.	Inorganic.	Organic.
Case I.	20.60	74.40	21.24	78.76	18.68	81.32
Case II.	37.80	62.20	20.00	80.00	32.29	67.71
Case III. . . .	20.89	79.11				
Case IV. . . .	52.85	47.15				

As might be expected, the relative proportion of the inorganic matter (the earthy salts) and the organic matter varies greatly in different cases. In severe rachitis many bones are affected. It is stated that there is no bone in the entire skeleton that may not suffer, but in mild cases only a few are involved, at least to such an extent as to produce structural changes appreciable to touch or sight.

Rachitic bone, when the disease is still in its active period, presents a bluish or dusky-red appearance from its increased vascularity. After a variable time —weeks or months according to the severity of the disease—deformities begin to appear.

2. **Anatomical Characters of the Stage of Deformity.**—CHARACTERS OF THE RACHITIC FŒTUS.—Spiegelberg's description of the rachitic fœtus corresponds for the most part with what I observed in the one whose skeleton is represented in a foregoing page. According to this writer, the body and limbs are plump, the latter short and curved, the abdomen large and prominent, and the head sometimes hydrocephalic. The skin is well developed and movable, the adipose tissue sufficient, the liver large, the epiphyses swollen and soft, the short and curved diaphyses sometimes broken; the rotundity of the thorax is preserved, and the sternum is not carried forward, since there has been no respiration. The ribs in softness and liability to fracture correspond with the long bones of the extremities. The sternum, most of all the bones,

PLATE XIV.



RACHITIS.

shows the delay in ossification; the clavicle is among those least affected. The cranium may be represented by a membranous bag with plaques of bone, or the cranial bones may be formed and in shape, but thickened and softened; the sacral promontory is pressed forward and downward; the ilia flattened and widened; the pubic arch increased.

Characters of the Rachitic Child.—In typical rachitis the bone seldom retains its normal form or shape: its projecting points are rounded, and as soon as it softens it begins to yield to pressure exerted upon it. Hence the curvatures so common and characteristic. The portion of a long bone which is formed after rachitis commences contains so little earthy matter that it bends readily in its fresh state either by muscular action or by the weight of the trunk "in the manner," says Vogel, "of a quill or willow stick." The interior of the bone, which was formed before rachitis began, and which contains nearly or quite the normal proportion of lime, is likely to break instead of bending, but, as it is surrounded on all sides by the soft tissue, the fragments are not displaced, and probably do not crepitate. So scanty is the calcareous deposition in typical cases that, says Trousseau, "the bones . . . . can be cut with a knife with as much ease as a carrot or other soft root," and the dried specimen weighs from one-sixth to one-eighth of the weight of normal bone. One writer states that the dried rachitic bone is sometimes so porous from the small amount of lime which it contains that it is possible to respire through it as through a sponge.

In ordinary cases the bones which exhibit most strikingly the rachitic change, and which, therefore, should be examined carefully in making the diagnosis, are the cranial bones, the ribs, and the radius—the sternal ends of the ribs and the lower end of the radius. It is seldom that these bones do not give evidence of the disease if it be present, and in greater degree than other bones. They are the first to be affected to an extent that is appreciable to the observer.

Changes in the Cranial Bones.—In these bones interesting and important alterations occur. Their edges, which correspond with the epiphyseal cartilages of long bones, undergo proliferation, and become thickened like the latter. This thickening and the delayed union of the sutures produce grooves which can be traced by the fingers between the bones, and which are sometimes appreciable to the sight. Rachitis causes enlargement of the cranium, but the enlargement seems greater than it really is, on account of the retarded growth of the facial bones. In a discussion on rachitis in the London Pathological Society, reported in the London *Lancet* (1880, ii, 1017), it was stated that in seventeen rachitic children with an average age of 4.72 years, the average circumference of the head was 21.22 inches, while in the same number who were non-rachitic, and whose average age was 6.05 years, the average circumference was 19.95 inches. The retarded ossification is manifested not only in the open sutures, but also in the large size and patency of the fontanelles, which are not closed until long after the usual time. The anterior fontanelle in the healthy infant is closed at about the fifteenth or sixteenth month, but in the rachitic it remains membranous a longer time: in some cases it is still membranous as late as the third or fourth year. Since examination of the anterior fontanelle aids in determining whether or not rachitis be present, it should be borne in mind that in the normal state this space increases in size till the seventh month, when it is at its maximum, and that after the ninth month it becomes progressively smaller. Ossification in severe rachitis is retarded for a longer period than is stated above, for Gerhard relates a case in which the anterior fontanelle had not entirely closed at the ninth year.

The shape of the rachitic head varies. In general, instead of its normal rounded form it approaches a square shape. Another type is sometimes observed in which there is no marked angularity, but in which the antero-posterior diameter is enlarged. In the square head the forehead projects, and both the frontal and parietal protuberances are unusually prominent. The sutures are depressed to a certain extent, as has already been mentioned, and the anterior, lateral, superior, and posterior surfaces are more flattened than in health. The undue prominence of the frontal and parietal eminences is largely due to the exaggerated proliferation of the periosteum and to the vascularity and infiltration underneath. Enlarged veins are seen ramifying in the scalp, which in marked rachitis supports a scanty growth of hair. The free perspiration from the scalp, and in some cases the activity of its sebaceous follicles, will be mentioned elsewhere.

Craniotabes.—Thinning of the cranial bones in places, so that the brain lacked proper protection, had long been noticed in the examination of rachitic heads, but the injury that resulted to the infant was overlooked until pointed out by Elsässer. Craniotabes occurs for the most part in infants under the age of one year, and a large proportion are under eight months. Its occurrence in the fœtus, as shown by a case published in the *New York Obstetrical Journal* in 1870, and by Heitzmann's case, has already been alluded to. The factors in producing this thinning are rachitic softening of the bones and pressure from the brain within and from the pillow without. Consequently, the portions of the cranium in which the thinning is most pronounced are the posterior and lateral, the occipital bone and the posterior half of the parietal. If the infant lie in its crib chiefly on one side, on this side the craniotabes occurs, while those portions of the cranium which are not pressed upon exhibit no thinning or a less degree of it. The soft spots in the cranium are yielding when pressed upon, and in the cadaver they are seen to be translucent when the bone is held to the light. There are in some instances simple depressions like erosions in the bone, a continuous but thin bony layer remaining. In other cases, such as have been particularly examined and studied by physicians, the bony absorption has been complete over areas of greater or less extent. On examining a child for craniotabes it should be borne in mind that the margins of the cranial bones, even when there is no thinning, but thickening from the cartilaginous proliferation, are flexible in the rachitic. The pressure must be made in a direction away from the sutures to ascertain whether craniotabes has occurred. The pressure should at first be made lightly and cautiously with the fingers, for if there be total absence, unless of very little extent, deep and forcible pressure might injure the brain, since so soft and delicate an organ, covered only by scalp and dura mater, badly tolerates pressure. If the first examination detect no soft place, the fingers may be pressed more firmly against the scalp, when, if the bone be much thinned, so that there is only a small layer of lime salts underneath, it will be found to yield. The sensation communicated to the fingers when there is an open space in the cranium, and the dura mater and scalp are in contact, has been likened to that experienced when pressing upon a fully-distended bladder. At a meeting of the London Pathological Society, reported in the *Lancet* for November, 1880, Dr. Lees presented statistics to show that craniotabes is one of the lesions of inherited syphilis; but whether it does sometimes result from inherited syphilis or not, the evidence that there is a cranial softening which is strictly rachitic, and which occurs in those who have not inherited syphilis, appears from reported observations to be conclusive.

Changes in the Vertebræ, etc.—The short bones which participate in the rachitic disease become softer and more yielding, and their cancelli are filled

with a reddish pulpy substance. In many rachitic cases the vertebræ are but slightly involved, so that no deformity of the spinal column results; but occasionally, when many bones are affected, the vertebræ and intervertebral carti-

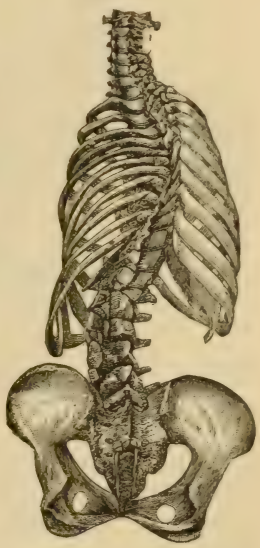
FIG. 2.



Head of a Rachitic Child in the New York Infant Asylum. This child also had laryngismus stridulus.

lages soften, and spinal curvatures result. The curvatures are due to the weight of the shoulders and head on the spinal column. They are, with some deviations, an exaggeration of those present in the normal state. Rachitic curvatures of the spinal column are therefore mainly antero-posterior, often with more or less lateral deflection. When there is much curvature the vertebræ become wedge-shaped, narrowed upon the concavity and thickened upon the convexity. The intervertebral cartilages are also more or less changed by the pressure, being thinned where the vertebræ approximate to each other on the concave aspect of the curvature, and of normal thickness or thicker than normal upon the convexity. The accompanying wood-cut exhibits the appearance and nature of rachitic spinal curvature continuing into adult life. Rachitis, having occurred at the usual age, resulted in the permanent deformity here illustrated.

FIG. 3.



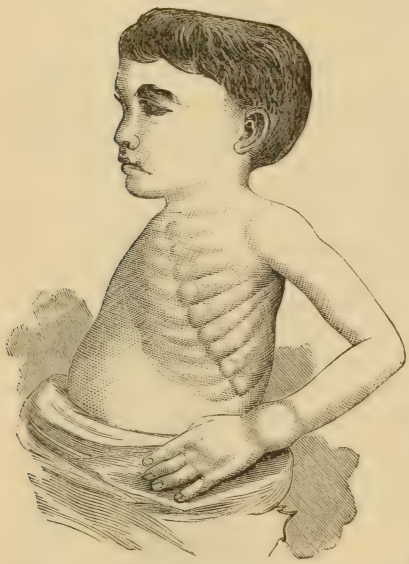
Rachitic Spinal Curvature in an Adult (from a specimen in the Wood Museum, Bellevue Hospital).

In extreme cases, fortunately rare, the functions of important organs may be seriously impaired by the curvature and consequent compression, as they are in Pott's disease. Thus, according to Miller, the aorta has been so doubled upon itself as to materially diminish the flow of blood to the lower extremities, so that their nutrition was sensibly impaired. The effect of so great curvature upon the heart and lungs must obviously be detrimental. At first the spinal curvatures disappear when the child reclines or is lifted by the axillæ so as to raise the head and shoulders from the spine; but when the deformity has continued so long that the vertebræ and cartilages have become

wedge-shaped, it remains for life or can only be rectified slowly and with difficulty by mechanical appliances. As seen in the wood-cut, the common curvature in the dorsal region is backward (kyphosis), while to compensate the patient instinctively carries the neck forward, with the head thrown back, causing cervical lordosis, a similar anterior curvature being common in the lumbar region. Lateral curvature (scoliosis) may or may not be present even when there is considerable antero-posterior flexure. Scoliosis is sometimes produced by the nurse in carrying the infant habitually over one arm.

Changes in the Maxillæ.—Fleischmann has investigated the changes which rachitis produces in the maxillary bones. Stunted growth of the facial bones, generally, has long been known, and has been remarked upon by various writers; but, according to Fleischmann, other interesting changes occur in the jaw-bones which affect the direction and position of the teeth. According to this observer, the arched shape of the lower jaw becomes polygonal, and the direction of its alveoli also changes, so that they incline inward. This deviation in the arch and in the alveolar border of the lower jaw, which begins in the region of the canine teeth, necessarily causes softening of the jaw. Commencing soon after, a change is observed in the upper jaw-bone from the zygomatic arch forward, so as to cause lengthening of this bone, changing the shape of the arch and the position of the teeth. The external incisors, instead of being in front, have a lateral position, and when the jaws are closed the superior incisors and molars overlap the corresponding teeth of the lower jaw in front and upon the sides—a condition opposite to that seen in the jaws of old people. Fleischmann attributes these changes in the lower jaw to the action of the masseter and the mylo-hyoid muscles, and perhaps the genio-glossus, and to pressure of the lip, the deficiency of earthy salts in the bone rendering it more easily acted on by the muscles. The change in the upper jaw-bone he attributes largely to lateral pressure of the zygomatic arches.

Fig. 4.



Rachitic Child with characteristic deformity of head and ribs. (From a patient in the New York Foundling Hospital).

Changes in the Ribs.—The ribs are easily affected in rachitis. The swelling of their anterior ends, where they unite with the costal cartilages, producing the "rachitic rosary," has been already alluded to as one of the first and most conspicuous signs of rachitis. The costochondral articulations are enlarged in all directions, appearing as nodules under the skin. If at an autopsy an opportunity of inspecting the pleural surface of the articulation occur, the nodular prominence is seen to be even greater and more distinct than under the skin (Fig. 4).

The deformity of the thorax, consequent upon softening of the ribs, is interesting. Commencing with the spine, the ribs extend nearly directly outward: at the union of the dorsal and lateral portions they make a short curve forward and then turn inward, also with a short curve, toward the sternum

(Fig. 5). This abrupt bending of the ribs, which in their softened state has been caused by atmospheric pressure during respiration, produces a depression in the thoracic wall at about the point where the ribs and their cartilages unite. A groove extends on the antero-lateral aspect of the thorax from the second or third rib downward and a little outward. In some cases the costo-chondral articulations are in the line of greatest depression in the thoracic walls; in other cases they are a little inside or outside of the deepest part of the groove. The transverse diameter, therefore, of the anterior half of the thorax is less than that in the normal rotund form of health. This necessarily diminishes the antero-lateral expansion of the lungs in inspiration and causes unusual prominence of the sternum. Hence the expressions "pigeon-breasted," "resemblance to the prow of a ship," etc. applied to this deformity. The presence of the heart renders the depression or groove less on the left side between the fourth and sixth ribs than on the opposite side, since this organ affords partial support to the chest-wall. On the other hand, the depression on the right side below the sixth or seventh rib is, on account of the support given by the liver, less than on the left side. But on the left side, as well as on the right, the lower part of the thorax, that below the eighth or ninth ribs, widens, being pressed outward and supported by the abdominal viscera. This gives rise to an antero-lateral furrow or groove near the base of the chest, sometimes designated Harrison's groove.

The ribs with their attached muscles are important agents in respiration, but their soft and yielding nature in the rachitic retards, and to a great

FIG. 5.



Deformity of Chest in Rachitis.

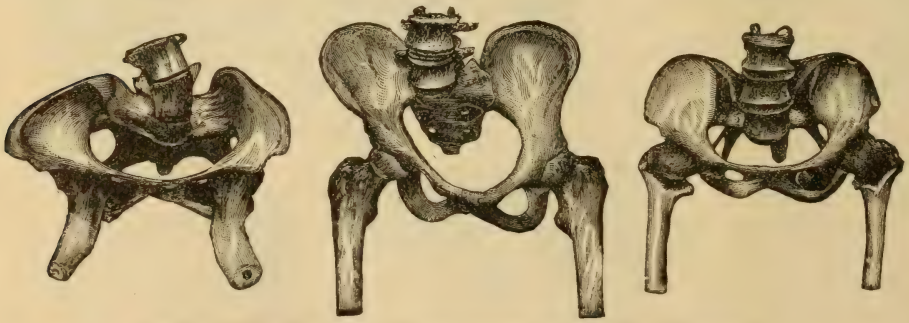
extent prevents, the lateral expansion of the thorax which is necessary for normal and full inspiration. The action of the respiratory muscles and the pressure of the air from within descending along the air-passages is not suffi-

cient to fully overcome the external atmospheric pressure in the absence of the proper resiliency of the ribs. Consequently with each inspiration we observe more or less sinking of the thorax on each side, just as when a moderate obstruction to the entrance of air exists in the larynx or trachea. As the ribs become firmer from the deposit of lime salts, respiration is more regular and normal.

Changes in Bones of Upper Extremities.—Although swelling of the lower end of the radius is one of the earliest signs of rachitis, the bones of the upper extremities are less frequently curved and distorted than those of the lower extremities. The clavicle sometimes softens and bends, producing two curvatures—one backward near the scapula, and another, of larger radius, nearer the sternum, directed forward and a little upward. Careful examination shows, in some rachitic patients, thickening of the margins of the scapulæ like that of the cranial bones. The humerus is occasionally bent, and usually at the insertion of the deltoid in consequence of the powerful action of this muscle in raising and supporting the arm. The radius and ulna are bent outward and twisted. This deformity is attributed by Sir William Jenner to the fact that rickety children support themselves while in the sitting posture upon the palms of the hands pressed upon the floor or couch. Supporting the weight of the body in this manner not only, in his opinion, causes bending of the ulna and radius, but also aids in producing the deformities of the humerus and clavicle.

Changes in the Bones of the Pelvis.—The deformities of the pelvic bones resulting from rachitic softening are very important in the female infant, since pelvic deformities during the procreative period are the common cause of tedious or instrumental labor and stillbirth. These deformities, which elongate some and contract other axes of the pelvis, necessarily occur when the rachitic child is in the erect position, since the pelvic bones support the weight of the trunk, head, and shoulders. A common deformity produced in this manner is the carrying forward of the promontory of the sacrum, which sustains the weight of the spine. There is, moreover, twofold pressure from below —that caused by the heads of the thigh-bones in standing, and that exercised by the tuberosities of the ischia in sitting. Both these forms of pressure have a tendency to narrow the outlet of the pelvis. Hence the marriage of the female who has been rachitic in infancy may involve serious consequences.

FIG. 6. FIG. 7. FIG. 8.



Rachitic Deformities of the Pelvis (from specimens in Wood's Museum).

Many of the tedious instrumental labors in the families of the city poor, which severely tax the patience and endurance of young practitioners, are attributable to rickets in early life.

Changes in the Bones of the Lower Extremities.—The curvature of the femur is usually forward or forward and outward. The neck of the femur sometimes bends by the weight of the body or by use of the legs, so that the

Fig. 9. Fig. 10.

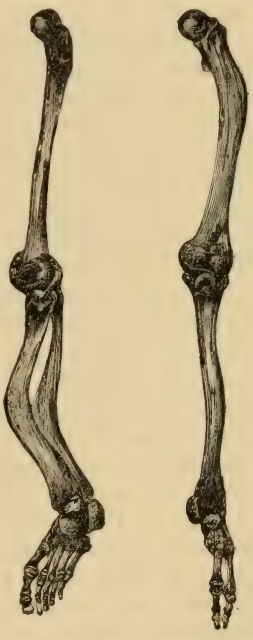


Rachitic Deformities of the Femur (Wood's Museum).

angle which it forms with the shaft is changed. The accompanying wood-cuts show the rachitic bend of this bone in an adult, years after rachitis had ceased and when the bone had become consolidated by the new deposition of lime salts. (Figs. 9 and 10.)

The curvature of the tibia and fibula varies in different cases. In those under the age of one year it is likely to be outward, so that the knees are separated from each other. In those old enough to stand, the weight of the body usually determines a forward bending of these bones. In one case in my practice an anterior curvature, so abrupt that an angle of about 70° was formed, existed about five inches above each ankle. This patient, although old enough to walk, almost constantly sat during the day with the feet extended beyond the sofa, so that the edge of the latter corresponded with the abrupt curvature or angle of the legs. It seemed that the weight of the feet, unsupported beyond the edge of the sofa, had caused these curvatures, especially as the case was one of very marked rachitic softening of the different bones.

Fig. 11. Fig. 12.



Rachitic Deformities of the Femur, Tibia, and Fibula (Wood's Museum).

Still, tibial and fibular bending at this point has been noticed by different observers, who have attributed it to the weight of the body in walking. Various other curvatures besides those mentioned occur in the bones of the lower extremities, the direction in which the limbs bend being determined by the particular circumstances of the case. In mild cases of rickets most of the deformities described above may be lacking, but in typical cases certain of them stand out prominently, so as to be readily detected by one familiar with the disease. In all such cases the nature of the malady is apparent, for the changes that occur are not only conspicuous, but pathognomonic.

Rachitis produces another important effect on the skeleton. Its growth is stunted, not only during the rachitic period, but subsequently, so that those who have been rachitic in childhood, unless very mildly, have less than the average stature in adult life. The stunted growth is apparent, though ample allowance be made for curvatures. The arrest of development is greater in some bones than in others. It is greatest in the bones of the face, pelvis, and lower extremities. Stunted growth of the pelvic bones of the female infant, conjoined

with the deformities alluded to above, may seriously affect her subsequent life, for the stunted development of the pelvic bones, like the deformities mentioned above, constitutes a valid reason for avoiding marriage. As a rule, the older the child is when rachitis begins, the less is the skeleton affected and the less, consequently, is the deformity.

Effect of Rachitis on Dentition.—As might be expected from the nature of rachitis, dentition suffers severely. The delay in dentition has been considered elsewhere in this paper. Teeth which appear during the rachitic state are frail, deficient in enamel, and crumble readily. They decay and break before the usual time. If certain teeth have appeared before rachitis begins, several months elapse before others cut the gum. It is even said that a child who has rachitis severely for a lengthened period may never have a tooth, and may remain toothless for life; but I have never observed such a case. Ordinarily, when the rachitic state ceases and the health is fully restored dentition goes on in the normal way.

3. **Anatomical Characters of the Stage of Reconstruction.**—This stage will be better understood if we recollect what has occurred during the first and second stages. The very vascular periosteum is drawn tightly over the convexities, the pressure upon which diminishes the hyperæmia and the amount of exudation underneath. Over the concavities the periosteum is loose: it is hyperæmic with abundant new capillaries, the interspace between it and the bone being filled with the exuded soft material having a gelatiniform appearance. The reparative process goes forward rapidly, the deposition of lime salts being more abundant upon the concave surfaces, where there has been free exudation with no compression of the capillaries, than elsewhere. The lime salts are deposited from the blood. Consequently, from the increased capillary circulation and hyperæmic state of the periosteum produced by rachitis, the earthy material is rapidly deposited wherever there is an open space under the periosteum and where the capillaries are in a state of enlargement. Hence the reconstructed bone is thicker and firmer upon the concave aspect of the long bones than elsewhere, and thinnest upon the convex aspect, where the periosteum is more tense and its capillaries more or less compressed.

Normal ossification does not at first take place during the reparative stage. The deposition of the earthy salts is designated by some writers as a petrifaction rather than a true bone-formation. Trousseau likens it to the formation of a callus upon a fracture. A deposition occurs of lime salts more compact than ordinary bone. The term "eburnation" has been applied to this new osseous formation, and I have designated it osteo-sclerosis. It resembles, as regards its hardness and morphological appearance, the enamel of the tooth rather than true bone, the Haversian canals and lacunæ being small and imperfectly formed. Of course after complete recovery the subsequent formation of bone is normal. Recovery from rickets is gradual. Little by little the cartilaginous and periosteal proliferations cease, the hyperæmia abates, and the various parts of the osseous system and the soft tissues resume their normal function and development.

General Symptoms of Rachitis.—Preceding and accompanying rachitis symptoms may be present which are due to indigestion and intestinal catarrh, such as flatulence, unhealthy stools, and poor and capricious appetite. When rachitis begins the infant becomes fretful; its sleep is frequently restless and disturbed, and it awakens often. It repels attempts to amuse it, and is apparently annoyed by them. Nurse and mother speak of it as a cross child. It perspires freely from the head and neck both when awake and when asleep, while its extremities and trunk are dry. Its pillow is wet with perspiration during sleep,

and sweat-drops may be seen upon forehead and face. If the surface be dry, a little excitement or elevation of temperature causes perspiration to appear. The rachitic child does not well tolerate the bed-clothes, and it attempts to throw them off from its limbs, even in cool weather lying exposed and causing considerable annoyance to the nurse, who strives to prevent its taking cold. Sometimes miliaria due to the moist state of the skin appears upon the face and neck. We have elsewhere stated that the subcutaneous veins that return blood from the head are large and the jugular veins full. Another symptom is soon observed, to wit: tenderness over a considerable part of the surface, perhaps largely due to the morbid state of the periosteum over so many bones, though it is also experienced when pressure is made upon soft parts, as the abdomen. The tenderness is probably the cause in part of the fretful disposition. The little patient appears to dread to be touched; its flesh is sore; it repels attempts to amuse it, and wishes to be quiet. Dangling it upon the arms, swinging it, or even walking with it, which delights the healthy child and elicits a smile or notes of glee, only adds to its discomfort. It is most at ease when left alone upon a soft cot or pillow, or, if it have craniotabes, when quietly held over the shoulder. Languor, disinclination to use the limbs or to play, moderate thirst, with other symptoms referable to the digestive apparatus which are present in many cases, and which have already been described, are soon followed by changes in the skeleton that are perceptible to the sight and on palpation. The pulse and temperature in a large proportion of the ordinary chronic cases do not deviate from the healthy state, except that in some patients there is a moderate rise in temperature and acceleration of the pulse in the latter part of the day, indicative of a slight fever.

A *bruit de souffle* of greater or less intensity, synchronous with the pulse, has frequently been heard in rachitic cases by applying the ear over the anterior fontanelle. Drs. Whitney and Fischer, New England physicians, first called attention to this murmur, believing it to be a sign of chronic hydrocephalus. MM. Rilliet and Barthez heard it in cases of rachitis, and therefore concluded that the American physicians had confounded the two diseases. More recent observations have established the fact that this bruit has little diagnostic significance. It is heard whenever there is sufficient patency of the anterior fontanelle both in health and disease. It is conducted from the base of the brain through the brain-substance to the membranous covering of the fontanelle. Dr. Wirthgen heard the bruit in 22 of 52 infants, of whom all except 4 were in good health. I have auscultated the anterior fontanelle in 29 infants who were, with two exceptions, between the ages of three and thirty months. All were well or affected merely with trivial ailments which did not disturb the cerebral circulation. In most of them a murmur could be distinctly heard synchronous with the respiratory act, and in 15 of the 29 cases no other sound could be detected, while in the remaining 14 a bruit could be detected synchronous with the pulse.

As might be expected, craniotabes gives rise to symptoms quite distinct from those of the general rachitic disease. It usually occurs during the first year of infancy, and most frequently prior to the tenth month. The brain at this age is soft and yielding, since it contains a large percentage of water. Unless handled with care at an autopsy, it is readily lacerated, and moderate pressure upon it is seen to disturb and move it a considerable distance from the point of contact. It will assist to a proper understanding of the symptoms referable to the cerebro-spinal system to which the rachitic are liable, to recall to mind the fact, well known to surgeons, that slight depression of even a small portion of the skull is likely to produce grave consequences. It is not surpris-

ing, therefore, that craniotabes, when there is a space of considerable size in the cranial arch destitute of bone, is attended by symptoms due to the mechanical effect of external pressure whenever a substance less yielding than the brain comes in contact with the unprotected part.

Every rachitic child is fretful, but one with craniotabes is especially so if the open spaces, in which the lime salts are lacking or constitute a thin and yielding layer, are of considerable size. If the child lie upon the pillow in the position that is most natural for it, the unprotected portion of the brain may be so pressed upon by the weight of the head that it is uncomfortable and restless. It does not have quiet sleep because the cerebral circulation and functions are disturbed because of the fact that the cranial arch no longer protects the brain from undue pressure. Carefully placed in an apparently comfortable position, it awakens often and frets until it is taken in the nurse's arms. Sometimes it instinctively seeks a position on the edge of the pillow, with its face downward, and it becomes more quiet when resting over the nurse's shoulder with no pressure or support upon the cranial arch.

But if fretfulness, disturbed sleep, and the necessity of closer attention on the part of mother and nurse were the only ill effects of craniotabes, it would possess much less pathological significance than pertains to it. Pressure upon so delicate and important an organ as the brain involves risks and produces serious symptoms in proportion to its degree. Even a slight injury of the skull which causes depression, though it may be of trifling amount, will cause serious forms of nervous disorder. Rachitic craniotabes sustains a causal relation in not a few instances to one of the most dangerous of the neuroses—to wit, *laryngismus stridulus*, or spasm of the glottis. Pressure on the cardiac and vaso-motor centres of the medulla in the rachitic infant, in whom reflex excitability is exaggerated, causes contraction of the muscles that close the glottis. It is certain that a large proportion of those who suffer from laryngismus stridulus are rachitic, so that it is more common and severe where rachitis is prevalent, as in England, than where it is rare, as in the rural districts of America. It is not often the cause of death in America, and the fatal cases that do occur are, I think, nearly always in the cities, whereas in parts of Europe, where rachitis is much more common than with us, it is said to cause not a few deaths.

Certain infants when in a state of excitement have what are termed "holding-breath spells." The face is flushed and breathing ceases for some seconds, after which respiration returns and is normal. The attacks are unimportant, but they appear to be the same in nature with the more severe and dangerous seizures of laryngismus stridulus. They have no pathological significance, excepting that they show the same neuropathic state as that in laryngismus, and that they may be precursors of it.

Laryngismus stridulus, or glottic spasm, is usually preceded by more or less impairment of the general health and often by fretfulness, which is characteristic of the rachitic state; but the attack occurs suddenly, without premonition, and is of short duration. It begins with an arrest of respiration, a true apnœa, as if from paralysis of the respiratory centre in the medulla; the lips may be livid, a pallor spreads over the face; sometimes more or less rigidity of the limbs occurs, with carpo-pedal contractions. After a few seconds, a quarter or half minute, a long and deep but difficult inspiration through the narrow chink of the glottis follows, accompanied in many patients by a whistling or crowing sound, and the attack ends with perhaps a momentary appearance of bewilderment or dread on the child's face. Laryngismus stridulus, like eclampsia, does not have a uniform causation. In certain cases it is a reflex phe-

nomenon due to an irritant in some part of the system, as in the intestines, but many observations establish the fact that rachitis is probably its most common cause. A large proportion of the infants affected with it exhibit unmistakable rachitic signs; and it has been held that the exposed state of the brain in craniotabes affords explanation of the symptom. But from observations which I have made and from those of other observers, like Senator, it is certain that laryngismus stridulus is common in the rachitic who do not have craniotabes, so that there must be a causal relation in rachitis to spasm of the glottis independently of the cranial softening.

Distinguished British observers, as Gee and Jenner, have noticed the fact that rachitic infants are especially liable to *eclampsia*. The immediate or exciting cause seems to be in many cases the severe catarrh of the respiratory and digestive systems to which rachitic infants are especially liable. Indigestion, flatulence, and fermentative diarrhœa, common disorders of the rachitic, are perhaps, in some instances, the exciting causes of the eclampsia. Similar remarks may be made in reference to tetany, which, although it occurs in the adult and is comparatively rare, appears to be more frequent in rachitic than in other children.

Those physicians who attend in institutions in which children coming from tenement-houses are treated in a large city like New York have noticed the fact that the various tissues of the body, besides those that are conspicuously affected in rachitis, are more liable to inflammatory diseases than are the same tissues in those who have sound constitutions. The frequency of the different forms of dermatitis, of nasal, post-nasal, faucial, and bronchial catarrhs, and of gastro-intestinal maladies, we must attribute to the fact that rachitis diminishes the resisting power to noxious agents in the various soft tissues, and renders them more liable to disease.

If the deformity in the thoracic wall—to wit, the lateral depression of the ribs and anterior projection of the sternum—be great, we would naturally expect that the two important organs underneath, the heart and lungs, would receive some detriment. Upon the surface of the heart, at the point where it supports the softened ribs, a white patch is often found, due to thickening of the pericardium and proliferation of the endothelial cells, just as thickening of the skin in the palm of the hand occurs from friction and pressure upon that part. It is probable that in ordinary cases this pressure does not seriously impair the function of the heart, but it may increase the weakness of its movements in supervening asthenic diseases, which may occur during the rachitic period. The injury sustained by the lungs is greater and more apparent. If the lateral depression of the ribs be considerable, full inflation of the lungs does not occur in those parts where the depression is greatest. The semi-collapse of certain lobules is likely to occur, and even complete collapse of the distant thin edges of the lungs. The stress of respiration falls unequally upon different parts of the lung. The anterior portion, which ascends with the sternum as that is propelled forward, is more fully dilated than the lateral and posterior parts, and it may in consequence become emphysematous. If in this state of the thorax and lungs severe bronchitis or broncho-pneumonia occurs, the muco-pus, being expectorated with difficulty, clogs the tubes, produces dyspnœa, and imperils the safety of the child. Even in comparatively mild forms of inflammation the result may be unfavorable, owing to the lack of full expansion in the lateral and depending portions of the lung—a condition required to expel the mucus. Severe bronchitis and broncho-pneumonia are the causes of death in not a few cases of rickets attended by marked deformity of the thorax.

Rachitic Paralysis.—In not a few instances in the course of rachitis the use of the limbs is greatly impaired, so as to resemble paralysis, and be designated by this name, though the term "paralysis" is probably a misnomer. Cases like the following, related by Dr. H. W. Berg in the *New York Medical Record*, which closely resemble paralysis, occasionally occur: J. S——, aged two years and eight months, was admitted into the Orthopædic Dispensary Sept. 23, 1885. The parents stated that the child had never walked or stood alone. The legs were wasted, apparently from disease; the patellar reflex was good; there seemed to be some rigidity of the muscles about the knee; and the patient was admitted with the diagnosis of "spastic paralysis." A closer examination disclosed the fact that the disease was one of typical rachitis, and by the use of the proper diet, with iron and phosphorus, the patient was able to walk in November, and in a few months was entirely cured. The *British Medical Journal*, Jan. 4, 1890, contains the account of a case of rickets discussed by the Edinburgh Medical Society, Dec. 4, 1889. The patient, a boy of three years, had the waddling gait and straddling pose of pseudo-hypertrophic paralysis. The rachitic nature of the malady was made apparent by the symptoms of the case and its history. I have recently in private practice observed two similar cases of pseudo-paralysis of the lower extremities from the same cause.

Acute Rickets.—Occasionally rachitis occurs with the sudden development of severe symptoms, so that the term "acute" is applied to it. Dr. Fürst relates such a case in the *Jahrb. für Kinderh.*, Band xviii. p. 192: The patient, aged two years and one month, had been largely fed upon starchy food, and at six months had dyspeptic symptoms and sweating. Dentition began in the thirteenth month, and ability to walk several months later. Spasmodic croup and swelling of the epiphyses appeared at this time. At the above-mentioned age the child suddenly fell ill with acute febrile symptoms. It had an open anterior fontanelle, craniotabes, and a rachitic chest; upper extremities free from pain and not swollen. The left femur and both tibiæ showed diffuse cylindrical swelling. The appearance and feel of the limbs were suggestive of diffuse cellular infiltration proceeding from the periosteum in an attack of osteo-myelitis. The skin covering the limb was tightly drawn and of a reddish hue. In a few days the right forearm was affected, and soon after the right arm and left forearm, and the parts first attacked began to improve. In four weeks the fever and pain had abated, but swelling of the epiphyses and deformities of various bones continued. Cases like the above establish the fact that although rachitis is ordinarily a chronic disease, insidious in its commencement, gradual and progressive in its development, occupying months, there is an acute form which is attended by more marked febrile movement and tenderness than occurs in the usual type, and in which the articular swelling appears more quickly.

Treatment.—Hygiene.—We recall the recent statement of Prof. Henoch of Berlin that the spread of rachitis has been enormous in the cities of Central and Northern Europe. The poor of these cities, among whom this disease largely prevails, are emigrating in large numbers to the United States, but, as I have observed in the asylums and dispensaries of New York, the severest forms of imported rachitis come from Southern Europe (Italy). Evidently, as long as the influx of this class of foreigners continues, and the present insanitary conditions exist in our cities causing rachitis in the native born, this will continue an important disease, impairing the health and vigor of coming generations. It is evident from the nature of rachitis that success in preventing it and in curing those who unfortunately exhibit its characteristic signs

requires beyond anything else the employment of proper hygienic measures. The details of the hygienic requirements may seem prolix and tedious, but we cannot expect any marked diminution of rachitis until they are better known and heeded by the masses.

The fact that inheritance is one of the recognized causes of rickets renders it very important that the parents be in good health. The mother especially should avoid all agencies or influences which impair the general health during the procreative period. She should, so far as possible, encourage good appetite, take plain, easily-digested, and nutritious food, and lead a quiet, regular life, with sufficient out-door exercise to promote, so far as practicable, a state of perfect health. Country residence, with quiet exercise in the open air, a diet consisting of fresh vegetables, meats, fresh and abundant milk, early retirement to bed and sufficient sleep, are much more conducive to the health of the mother and her child than are the excitement and irregularities of city life.

We have seen that there is sufficient clinical and experimental evidence that the common and predominating factor in causing rachitis is the use of a faulty diet, but general insanitary conditions are also potent agents. The foul air and noxious effluvia of the crowded tenement-house, so conducive to disease and fatal to infants in New York, should, if possible, be avoided. Even if poverty compels a residence in the small and dark apartments of a tenement-house, crowded by families, many of them entirely neglectful of sanitary measures, yet parents solicitous for the welfare of their children can do much to diminish the insanitary influences which surround them. Out-door air is everywhere available, and every child after the age of two or three months, unless suffering from acute disease, should in ordinary weather be in the open air one or more hours each day, as a means of improving its digestion and of producing a more vigorous state of the system. Any mother or nurse capable of the care of a child should be able to employ such measures as will prevent its taking cold while in the open air.

The room occupied by a child, whether rachitic or not, should be at a uniform temperature of about 70° to 73° F., and it should receive the sunlight or the full daylight, which is often excluded by faulty construction. The undergarments worn during infancy and childhood should be of wool, thin and light during the summer, thicker and heavier in the winter. No intelligent mother need be told of the need of personal cleanliness of her child as a means of promoting its health as well as comfort. This is a hygienic measure, and we need not repeat that the more complete the sanitary conditions the less the liability to contract rachitis or any disease dependent on cachexia. Bathing of children should always be before the fire or in a warm room. The bath for an infant under the age of six months should be at about 90°. As the age increases the temperature of the bath should be gradually reduced to 80° in the second year, to 75° in the third year, and to 70° subsequently. The bath should be short, only long enough to ensure cleanliness. For weakly infants it is sometimes best to dispense with the general bath, and employ the sponge instead. I see no advantage in the use of saline or medicated baths. After the bath the extremities should be warm, and to ensure a better peripheral circulation friction of the surface by warm flannel or otherwise, or the application of warmth to the limbs, is often useful. The extremities of a child should always be warm, for the normal warmth of the surface not only promotes nutrition of superficial parts, but it tends to prevent internal congestions and inflammations, to which the rachitic are especially liable. A child that habitually has cool extremities cannot be at the maximum of health, and this is often the state of the poorly-fed and poorly-clad children of the tenement-houses. The

measures to promote their normal circulation and warmth, such as exercise as far as practicable, artificial heat, exclusion of cold by woollen garments, friction of the limbs, either dry or by the use of mildly stimulating lotions, should be employed. But while the hygienic measures which we have detailed are important as means of invigorating the system and rendering it less liable to rachitis as well as other cachectic diseases, we repeat that the most common and potent cause of the malady which we are considering is a faulty diet, so that in the endeavor to prevent and to cure rachitis special attention must be given to the feeding.

Clinical experience abundantly demonstrates the fact that in order to promote healthy nutrition the food of the infant should be breast-milk until the age of ten or twelve months; and subsequently, until childhood is well advanced, its food should consist largely of cow's milk, properly preserved and prepared.

We need not state that human milk varies in its composition according to the health, diet, mode of life, and temperament of the individual who furnishes it. Many mothers possess the requisite moral traits to be good wet-nurses, and do all in their power for the welfare of their infants, but have an inadequate lacteal secretion. Many mothers, not only in the tenement-houses, but in the well-to-do class, are unable to furnish sufficient breast-milk, and their infants, unless they receive supplementary food, suffer from malnutrition and are liable to become rachitic. I have seen during the last year infants wet-nursed by their mothers, fretful, wasted, and at the verge of starvation, applied every half hour to the breast during the hours of wakefulness. Mothers, deprived of the needed sleep and sacrificing their own health in the constant endeavor to provide for the wants of their infants, usually have insufficient milk, as in the cases alluded to. Under such circumstances a medicine designated nutrolactis, which consists largely of the Galega officinalis, has been employed in the New York Infant Asylum with apparent benefit as a stimulator of the lacteal secretion. But if suckling by the mother continue inadequate and her infant be under the age of six months, a wet-nurse should be employed. If this be impossible, supplementary feeding will be needed.

In normal and sufficient wet-nursing the infant should go to the breast at regular intervals of about two hours, but at longer intervals at night (ten times in twenty-four hours). It should obtain what nutriment it requires in ten or fifteen minutes, after which it falls into a quiet sleep. This allows the mother time and opportunity to rest and recuperate between the nursings, so that she furnishes milk more abundant and of better quality than when she is worried and anxious and deprived of needed sleep. The subject is so important that we may be allowed to repeat what we have elsewhere stated: An infant that draws the breast at short intervals of two hours obtains not only more milk, but richer milk, than when the intervals are longer.

There is no more important, and frequently no more perplexing, duty of the physician than to direct the alimentation of infants. Many mothers express the determination to wean for trivial reasons, and are found to be giving one of the commercial foods without consulting the physician. On the other hand, many mothers seriously declare that their babies are ravenous nursers, and that their breasts furnish an abundance of milk, when only a few thin drops can be obtained by the breast-pump, and the appearance of the nurslings plainly indicates innutrition and progressive emaciation. In such cases additional nutriment is of course required.

The practice, which is too common, of early weaning with insufficient reason and without consulting the physician, is very mischievous. Acute and transient ailments of the mother may cause some diminution in her milk, but

usually her health is not so injured by a short sickness that she is incapacitated for wet-nursing; of course the continued loss of appetite, with progressive debility and anæmia, may be such that prompt weaning is imperatively required.

If it be impossible to wet-nurse the infant, or if it have reached the age of ten or twelve months, at which time weaning is proper, it will be necessary to determine what food shall be given. In New York City—and the same is probably true in other cities—the infant should not be weaned in the hot months, since the change of diet from the natural to the artificial at this time is very likely to cause that fatal disease, the summer diarrhœa. The infant should be first removed to the country before weaning, or, if removal be impossible, weaning should be postponed until after the heated term, even if it be at the age of fifteen or sixteen months. But with a large proportion of infants after the age of six months the mother's milk is not sufficient, and it is necessary to supplement the wet-nursing by the use of other foods.

Notwithstanding the many commercial foods designed for infant feeding, I have every year been more and more convinced that cow's milk, properly prepared, furnishes the best substitute for human milk, and should be used to make up the deficiency when the latter is insufficient, and be the main food or the basis of the food employed after weaning. I have observed the occurrence of rachitis in children whose diet consisted chiefly of certain proprietary foods; and, in looking over the composition of these foods, one of the chief causes of this result appears to be the small amount of fat which they contain. Thus, according to Prof. Leeds's analyses, Mellin's Food contains only 0.15 part in 144.74, and Nestlé's Food only 1.91 parts in 139.69, whereas human milk contains 3.90 per cent. of fat, and cow's milk 3.66 per cent. of fat. Especially in the selection of food designed to prevent or cure rachitis our choice should fall on cow's milk next to human milk. But cow's milk contains five times more casein than human milk, and is slightly acid, whereas the latter is always alkaline. In the country, cow's milk obtained fresh and with proper attention to cleanliness in its manipulation may not require sterilization by heat. But that received and used in the city, exposed more or less to an atmosphere containing numerous microbes, it is well to sterilize by steaming for a period not exceeding twenty-five minutes. For infants with feeble digestion, who are suffering from innutrition, digestion of cow's milk can be promoted by peptonizing by the peptogenic powder of Fairchild in the manner well known to the profession. Inasmuch as observations relating to the causation of rachitis, which we have quoted elsewhere, show that deficiency of fat in the food is a common cause, I recommend, especially if any rachitic symptoms appear, the use of the upper half or third of the can or bottle of milk, since this contains a large percentage of cream.

A properly-prepared farinaceous substance, mixed with milk, not only has nutritive properties, but also, by mechanically separating the particles of casein, tends to prevent the formation of curds in the stomach. But as young infants digest starch with difficulty, a flour, as barley, wheat, or oatmeal, in which the starch is to a great extent converted into dextrin, or, better, into glucose, may be advantageously added to the milk, especially for infants over the age of six months. The conversion of starch into dextrin may be effected by a high heat, and into glucose by the action of diastase. If a heaped teaspoonful of barley flour be boiled in twenty-five teaspoonfuls of water, and when it is lukewarm ten or fifteen drops of diastase (Forbes) be added to it, the gruel in a few minutes becomes much thinner from the digestion of starch, and it is a useful adjuvant to the milk employed in the nursery, especially for infants over the age of six months.

But while healthy development in infancy and childhood requires a careful choice of food suitable for the stage of growth and development, the frequency of the feeding and the amount of food given are also matters of importance. There can be no doubt that many infants are under-fed, some even to starvation, and some infants are over-fed. MM. Vernois and Becquerel, in a careful examination of 89 infants wet-nursed by mothers apparently in good health, ascertained that 15 were insufficiently nourished. Did space permit I might relate instances in which infants were applied to the breast even more frequently than the prescribed rules allow by affectionate and devoted mothers or by wet-nurses supposed to have sufficient milk, and yet they continued to lose flesh and strength, were almost constantly fretful, and were finally reduced to a precarious state by insufficient nutriment. On the other hand, overfeeding sometimes occurs to the detriment of the child. A half century has elapsed since the most distinguished New England physician of his day, Dr. James Jackson, called the attention of the profession to the frequent, green, and unhealthy stools, showing imperfect digestion occurring in children from overfeeding. Among the cachexiæ developed from abnormal digestion and malnutrition we recognize rachitis as one of the most frequent.

A few years ago Drs. Chadbourne, Parker, and myself made observations in the New York Infant Asylum and New York Foundling Asylum in order to determine how much food children require at different ages. Those selected for observation were well nourished, and they were accurately weighed before and after each nursing or feeding. Eleven infants under the age of three weeks, who took the breast, with three exceptions, twelve times in the twenty-four hours, were found to take on the average 12.55 ounces of the breast-milk in the day and night. Therefore, according to these statistics, infants under the age of three weeks, nourished at the breast and suckled twelve times in the twenty-four hours, require only one ounce, or not more than one ounce and one drachm, at each nursing; and the very small size of the stomach at this age shows that it cannot receive much more than this without distention. After the third week the amount of food required for healthy nutrition gradually increases.

Children, like adults, in good health and well nourished, do not all require or take the same amount of food. Some need more food than others, but the following table indicates, I think, nearly the quantity required during the first twelve months of infancy, either of breast-milk or of food prepared so as to resemble as closely as possible breast-milk in consistence and nutritive properties. It will be observed that this table resembles closely that prepared by Prof. Rotch of the Harvard Medical School, and published in his instructive paper on infant feeding in the *Cyclopædia of the Diseases of Children:*

Quantity of Food required in the First Year of Infancy.

At each Feeding.	Number of Daily Feedings.	Total Daily Amount.
During the first week . . . . . 1 oz.	10	10 oz.
At the third week . . . . . 1½ oz.	10	15 oz.
At the sixth " . . . . . 2 oz.	8	16 oz.
At the third month . . . . . 3 oz.	8	24 oz.
At the fourth " . . . . . 4 oz.	7	28 oz.
At the sixth " . . . . . 6 oz.	6	36 oz.
At the tenth to twelfth month . . . 8 oz.	5	40 oz.

The daily average of food for each child in an aggregate of twenty-eight healthy children between the ages of two and three years was as follows: Bread, 7.5 oz. avoir.; butter, .98 oz.; meat (beef), 4.6 oz.; potatoes, 3.9 oz.; milk, 32.6 fl. oz. The daily average for each child in an aggregate of twelve children between the

ages of three and six years was as follows: Milk, 48.6 fl. oz.; beef, 12.1 oz. avoir.; rice, 13.0 oz.; bread, 10.3 oz.; butter, 1.08 oz. The daily average for each child in an aggregate of twenty-four children between the ages of four and ten years: Roast beef, 12.46 oz.; bread, 10.23 oz.; potatoes, 10.03 oz.; butter, .99 oz.; milk, 38.5 fl. oz.

The prevention and the cure of rachitis require strict enforcement of the details of hygiene. Hence the above facts relating to the mode of life and diet of children should be observed in order to prevent cachexia and promote a healthy growth.

Medicinal Treatment.—Medicines which aid the digestion and assimilation of properly-selected foods are sometimes useful. Irritability of the stomach, imperfectly digested stools, flatulence, colicky pains, etc. indicate faulty digestion, which may be improved by pepsin given with each feeding. Tonic remedies designed to improve the appetite and digestion, of a kind suitable for the age and condition of the patient, are often useful. In anæmia one of the readily-assimilated preparations of iron should be given. The complications which are so common require special management. The laryngismus stridulus, eclampsia, and tetany should be promptly treated.

The bronchial catarrh to which rachitic infants are liable may be best treated by remedies like the following:

℞. Ammonii chloridi . . . . . ʒj.
Syr. Tolutan. . . . . fʒij.—M.
Sig. Dose fifteen drops every hour or two hours for an infant of six to ten months.

℞. Ammonii chloridi . . . . . .
Ferri et ammonii citratis . . . . . *āā* ʒss.
Syrupi . . . . . fʒj.
Aquæ . . . . . fʒiij.—M.
Sig. Give one teaspoonful every two to four hours to a child of one year.

Some of the rachitic cases with protracted bronchial catarrh, especially those which also exhibit scrofulous symptoms, may be most relieved by the syrup of the iodide of iron and cod-liver oil administered three times daily, with the inhalation of moist air containing turpentine vapor.

In the protracted intestinal catarrh of rachitic infants I have observed the best results, so far as medicine is concerned, from the following prescription:

℞. Subnitrate of bismuth . . . . . ʒij–iij.
Essence of pepsin (Fairchild's) . . . . . fʒj.
Distilled water . . . . . fʒiij.—M.
Sig. Shake bottle; give half to one teaspoonful, according to the age, every two hours.

But a remedy is needed which will act promptly in the cure of rachitis so as to prevent the evil consequences which its continuance is sure to produce. It is the opinion of many of the best clinical observers who have had ample experience that this has been discovered in the daily use of minute doses of phosphorus.

Wegner fed young and growing animals (rabbits and fowls) for months with small, non-poisonous, and easily assimilated doses of phosphorus, with the result, he believes, of expediting ossification and producing firmer bone.

He states that under the influence of phosphorus the large marrow spaces diminish, by the formation of true bone, to the size of the Haversian canals in normal bone. According to Wegner, the administration of finely-divided, non-poisonous doses of phosphorus for a prolonged period to older fowls produced to a considerable extent the conversion of cancellous into compact bone of normal chemical composition. Kassowitz has recently promulgated his views at some length on the pathology and treatment of rachitis. He states that the lime salts are not needed, since the ordinary food contains sufficient lime; nor should the farinaceous foods be restricted. He adds that phosphorus in small doses restricts the formation of vessels in the growing bones of small animals. Hence it is useful as a means of overcoming the hyperæmia. Kassowitz administers about $\frac{1}{133}$ of a grain in a teaspoonful of cod-liver oil, the dose, of course, varying according to the age of the infant. The distinguished pædiatrist of Vienna, Dr. Widerhofer, says of this remedy that its employment "impresses him with the belief that it is not without benefit in the second year of life and upward." He thinks that it may be useful in the hardening of long bones, but he has not been able to obtain good results in craniotabes. Stärker gives an analysis of 23 rachitic cases treated by Prof. Thomas of Freiberg in his clinic. He used the following formula:

℞. Phosphori . . . . . 1 centigramme (about $\frac{1}{7}$ grain).
Ol. morrhuæ . . . . . 100 grammes (about 3 ounces).—M.

A coffee-spoonful was administered twice daily, but variations in the dose according to the age are not stated in the report, the patients being between the ages of a few months and four years. Improvement occurred in the general condition in 18 cases; in the cranial development in 15 cases; in dentition in 14 cases; in the shapes of the epiphyses in 21 cases; in locomotion in 17 cases; but strict attention was bestowed upon the hygiene, and especially upon the diet. Soltmann states that good results occurred from the use of phosphorus in 70 cases which he had under observation, and in no instance were unfavorable results noticed. W. Meyer obtained similar results in 42 cases. He regards phosphorus as a specific for rachitis. When properly given it always, says he, produces positive results. Petersen has treated 200 cases with phosphorus, and regards it as a specific. Sigel concludes, from the observation of 40 cases in private practice, that constitutional treatment is of the greatest importance, but instead of the administration of iron, lime, etc., phosphorus should be prescribed. Unruh also made many observations in the treatment of rachitic cases by phosphorus in the Dresden Hospital in 1885 and 1886, and considers it more efficacious than other remedies.

Toplitz of Breslau treated 518 cases with phosphorus combined with cod-liver oil. No ill effects were observed, and in all the cases improvement occurred in the general condition. Of 208 cases of craniotabes, 176 were cured in eight weeks. In 58 cases of laryngismus stridulus the attacks ceased in eight to fourteen days, after having continued for months under other forms of treatment. Dentition was also promoted.

In America, Dr. A. Jacobi, who has had a large clinical experience, also highly recommends phosphorus in the treatment of rachitis. The dose should be small, even minute, not more than $\frac{1}{200}$ to $\frac{1}{100}$ of a grain, according to the age, three times daily.

As regards my own observations, I am not able to express a positive opinion as to the value of the phosphorus treatment, for reasons which I think also apply to many of the cases embraced in the favorable statistics of the dis-

tinguished observers mentioned above—to wit, the simultaneous use of cod-liver oil and improvement in the diet and general hygiene.

The following prescriptions may be employed—first, the oleum phosphoratum, made according to the following formula:

℞. Phosphorus . . . . . 1 part.
Ether . . . . . 9 parts.
Almond oil . . . . . 90 " —M.
One minim contains $\frac{1}{100}$ of a grain of phosphorus.

Or, secondly, the following, known as Thompson's mixture:

℞. Phosphori . . . . . gr. j.
Alcoholis (absolut.) . . . . . ♏ cccl.
Spts. menth. piperit. . . . . ♏x.
Glycerini . . . . . f℥ij.—M.
Sig. Six drops, increased to 10, three times daily, to a child of two to four years. Ten minims contain $\frac{1}{132}$ of a grain, and thirteen minims contain $\frac{1}{100}$ of a grain.

Phosphorus should, I think, be given after the meals, in order to prevent irritation of the stomach.

Dr. H. H. Purdy, physician to the large class of children's diseases in the out-door Department at Bellevue, has preserved statistics of the treatment of rachitis during the last year. The cases which furnish the statistics numbered about 80, and he gives a résumé of the results of treatment as follows: "Some were given cod-liver oil alone, some, cod-liver oil with phosphorus, and others, phosphorus alone, and of course all the mothers were given instruction in feeding and hygiene. Those infants that received only phosphorus were the slowest to improve. Indeed, in several cases this method of treatment was abandoned because of the absence of the signs of improvement. The group treated with cod-liver oil did the best. In fact, all of the infants that could tolerate the oil derived much benefit from it. The group that were given cod-liver oil with phosphorus did very well, but seemingly no better than those that were given only cod-liver oil. The preparation that seems to be the most beneficial is one that is used at the Church Hospital and Dispensary. It is an emulsion of cod-liver oil made with the yolk of eggs. The formula for the emulsion is:

℞. Yolks of ten eggs.
Cod-liver oil . . . . . Oij.
Syrup of wild cherry . . . . . Oj.
Sherry wine . . . . . Oj.—M.

Sig. One or more teaspoonfuls administered three or more times daily."

In my opinion the treatment by phosphorus is still tentative, notwithstanding its recommendation by so many distinguished physicians; and the old remedies, cod-liver oil and iron, should not be abandoned, although trial may be made of phosphorus at the same time.

Care should be taken to prevent deformities while the bones are soft and yielding. The patient should not be encouraged to stand or use the limbs until they become firmer. He should lie upon a soft and even mattress. Uniform support of body and limbs is requisite in order to prevent curvature. In craniotabes the pillows should be soft, and care should be taken that the yield-

ing parts of the cranium be not unduly pressed upon. Profuse perspiration may be relieved by sponging with vinegar and water. The patient may be bathed in water a little cooler than the body, and rock salt may be added to the bath.

The attacks of laryngismus stridulus, eclampsia, and tetany which so frequently complicate rachitis should be promptly treated by the remedies which are appropriate when they occur under other circumstances. Constipation may be treated by enemata of glycerin and water if not relieved by change of diet.

The surgical treatment of rachitic deformities is sometimes important, but Prof. Ogston of the University of Aberdeen and other surgeons who have given special attention to this subject state that in young patients these deformities frequently diminish during growth, so as to cause little inconvenience in adult life. The measures employed by surgeons in order to cure or minimize the deformities are fully set forth in surgical treatises.

RHEUMATISM.

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I. Acute Rheumatism.

Acute rheumatism, or rheumatic fever, is a specific febrile malady characterized by inflammation of fibrous tissues, particularly those surrounding the joints, of which many are apt to become affected simultaneously or in succession. There is also in rheumatism a strong tendency for the serous membranes, especially those of the heart, to become involved, and in children we frequently find these bearing the brunt of the disease while the articular affection is very slight.

Etiology.—The cause of rheumatism is the accumulation of some poisonous matter in the blood which irritates specially the fibrous and serous tissues. The most commonly held opinion is that this poison is lactic acid, though the evidence is far from conclusive. The lactic acid may be the result merely of the morbid process, not the cause. Though sought for, specific micrococci have not been demonstrated, nor has the origin of acute rheumatism in disorder of the nervous system been proved.

But, whatever the remote cause, it is certain that chilling of the surface is in the majority of instances the immediate cause producing the attack. A history of exposure to cold and damp can be almost always obtained. In instances, on the whole infrequent, the poison of scarlet fever produces pain, swelling of the joints, and even cardiac symptoms indistinguishable from acute rheumatism.

The most potent predisposing cause of acute rheumatism in the young is hereditary tendency. Out of 492 cases Cheadle found a distinct history of its occurrence in near blood relations in 173. The strong hereditary tendency is also illustrated by the experience of Steiner: of 12 children of a mother who had suffered from acute rheumatism and heart complication, 11 had the disease before they were twenty years of age. Besides the complaint running in rheumatic families, I have noticed that the children of gouty parents develop rheumatism in greater proportion than found in those free from gouty taint. With reference to sex, unlike what happens in adult life, acute rheumatism is more common in girls than in boys. It is not often seen before six years of age. Yet August Seibert met with rheumatism in 13 children under one year of age, and cases of its occurrence in very young infants are recorded by Henoch, Senator, and Koplik. A case of acute rheumatism in an infant eleven days old is reported by Guthrie, and two remarkable instances of its manifesting itself soon after birth are mentioned by Jaccoud: one showed itself three days, and another twelve hours after birth, the mothers at the time being ill with acute rheumatism. I have myself met with a case of acute rheumatism under two years of age. This happened in a girl the daughter of a

highly gouty father. She has now grown to womanhood, having had three severe attacks of rheumatic fever, but without the heart becoming affected.

Morbid Anatomy.—The joints show an injected synovial membrane, and there is effusion of fluid into them and into the surrounding tissues; the fluid contains blood-cells and sometimes leucocytes. Minute hæmorrhages into the membrane are not uncommon; the cartilages are swollen, but it is very rare for them to suppurate or to ulcerate. Near the affected joints and tendons fibrous nodules similar to those found on the valves of the heart are met with, and the parts around the joints, as Henoch has called attention to, may be infiltrated with inflammatory exudation that even becomes as hard as bone. Nodules growing from the bone, a nodular periostitis, have been described by Angel Money. In the heart inflammatory lesions are usual, both in endocardium and in pericardium. The pericarditis in the acute rheumatism of childhood, Cheadle has pointed out, frequently extends to the anterior mediastinum, the connective tissue of which becomes extensively thickened. The extent of pericardial effusion is not generally great, but there is much plastic exudation in the membrane. Fibrinous coagula are found in the heart and great vessels. Pleurisy with or without effusion is often seen.

Symptoms.—The symptoms of acute rheumatism in childhood are the same as those of adult life: redness and swelling of the larger joints, pain, fever, perspiration, heart involvement. But these symptoms do not occur in the same degree. The *joint affection* is apt to be slight—certainly the swelling and redness are—while stiffness and tenderness may be marked. The joints become successively involved, but in children it is not uncommon to find the rheumatic inflammation limited to a very few joints, such as the ankles or the wrists. Even there it may be pain and tenderness rather than swelling that arrests attention. It is on account of the slight joint affection that acute rheumatism in children is often overlooked, and the pain and tenderness are attributed to a fall or a sprain until the damaged heart tells the story.

The *fever* is not high or long-continued; it is seldom above 102° F. Of those terrible cases with high temperature—temperature reaching from 107° to 110°—of which I have met with many in adults, I have never seen an instance in childhood. Fagge observed in 14 cases of the dreaded complication not one less than eighteen years of age; Wilson Fox, in 22 cases none less than seventeen years; Barlow records a fatal case in a girl of thirteen. Hyperpyrexia is certainly most unusual; and so are the cases with delirium and other signs of cerebral disorder, and the cases with typhoid symptoms, whether associated with high temperature or not. Where the febrile rise is high and protracted there is apt to be delirium, and the morbid signs generally depend upon a heart affection, especially pericarditis. The tongue is not so coated as it is in adults; the urine is high-colored, dense, with an excess of lithates. From among the usual symptoms of rheumatic fever we miss in children the profuse acid sweats. The skin is moist, but not bathed in perspiration.

The *heart symptoms* of the rheumatic fever of childhood occur very commonly; indeed, in children endocarditis and pericarditis are more usual attendants on acute rheumatism than in adults. Endocarditis shows itself by increased restlessness, hurried breathing, dry cough, uneasiness or pain in the cardiac region, a rise in temperature or at least a sustained fever temperature, and the development of a murmur, which is generally at or near the apex and systolic. This mitral murmur is followed by an accentuated second sound, or its reduplication, at the apex; in rarer instances in place of a mitral an aortic murmur is present; in yet rarer instances there is a diastolic aortic murmur, or a diastolic or a presystolic mitral murmur. The impulse is some-

what increased in force, slightly in extent, but the percussion dulness, difficult to ascertain in a child, is not distinctly altered. The pulse becomes more tense, and its beats are not equal. As the case advances, impaired pulmonary resonance and fine râles indicative of congestion may be noticed, and restlessness and anxiety and irregularity of the circulation augment. Where ulcerative endocarditis takes place, recurring chills like those of malarial fever, followed by high temperature and profuse sweats, are apt to occur. And both in this form and in the simple form of endocarditis masses of fibrin may be washed from the vegetations into the vessels of the brain or elsewhere, and cerebral embolism or embolic pneumonia or other kinds of embolism thus happen.

Besides the marked forms of endocarditis we may encounter only dulness of the first sound, giving it a murmurish character, without decided general symptoms attending the ill-developed cardiac changes. These are instances of mere swelling and slight inflammation, and rarely result in persistent alteration of the valves, as the cases with well-defined murmur commonly do. Then, again, it must be borne in mind that there are many cases in which the general symptoms are so slight that the endocarditis readily escapes detection. Indeed, it is alone the recognition of the changes in the heart-sounds that makes sure of the presence of the malady.

Pericarditis, owing to the greater difficulty of its recognition, is more often overlooked than endocarditis. This is especially the case in very young children, in whom, however, it is not common. It may occur at any stage of rheumatism: sometimes it precedes the joint affection; often it pursues a subacute, irregular course, subsiding and breaking out anew as fresh joints become involved. The symptoms are those of endocarditis, but there are greater restlessness and distress, more marked signs of nervous disorder, a tendency to higher temperature, more cardiac pain. The physical signs are the same as in the adult; prominent among them is the friction-sound, followed, when effusion takes place, by increased percussion dulness, by disproportionate distinctness of the sounds at the base as compared with those of the apex, by muffled sounds at the apex, and its upward displacement. It is much more difficult in children than in adults to make out the dulness, or to determine its triangular shape or its existence in the fifth interspace to the right of the sternum; and very often the dulness is of irregular shape, and dependent upon thick layers of plastic pericarditis, indicating its existence by coarse friction and by the sounds of the heart being much the same at the apex and at the base. This form of pericarditis without liquid effusion is, indeed, common in childhood.

So is *pleurisy* as an attendant upon acute rheumatism common, and not only single pleurisy, likely then to be left-sided, but double pleurisy. One of the dangers of left-sided pleurisy is that the inflammation is apt to spread to the pericardium; at all events, whether from contiguity or from simultaneous action of the rheumatic poison, pleurisy and pericarditis are often combined, and both may be of the exudative plastic variety rather than attended with effusion. Still, effusion does happen in rheumatic pleurisy, and may be of slow absorption or become purulent. *Pneumonia* rarely complicates the pleurisy; when it does, it may only reveal itself by rise of temperature, without marked cough or expectoration, and by the physical signs. Cheadle believes that these are different from those of pneumonia in the absence, except in the embolic form of the malady, of fine crepitation.

Chorea bears a very close relation to the rheumatism of childhood. Rheumatic children are very apt to be irritable, nervous, emotional children, and

therefore with nervous systems predisposing to chorea. The chorea associated with acute rheumatism has, in my experience, most generally shown itself toward the end of the attack and when the acute symptoms have disappeared. In the majority of instances there has been pericarditis or endo-pericarditis. Sometimes the choreic movements begin at the height of the malady, or the chorea even precedes the joint affection. It must further, in estimating the relation of chorea to rheumatism, be borne in mind that chorea does not always follow an acute attack, but may come on in those of rheumatic taint, without previous well-defined rheumatic manifestations.

Cutaneous eruptions are often seen in the rheumatism of childhood. The most common form is erythema, which appears on the limbs and the body, and is of the papulated or marginated form, or shows itself as urticaria, less often as erythema nodosum; in rare instances it is purpuric and associated with subcutaneous hæmorrhages. Barlow has pointed out that the erythematous rashes may appear simultaneously with pericarditis, or precede this and the articular symptoms.

But more important than these rashes, and much more strictly linked to rheumatism, are the *fibrous nodules*. Of extreme rarity in adults, they are not uncommon in children. They are mainly to be found about the joints, are hard and painless or slighly tender on pressure, of size varying from a pin's head to a cherry, and are chiefly to be ascertained by the touch. They come and go in a few weeks, though they may last for months. It is not unusual to have them appearing in crops, and, though these subcutaneous nodules may project from the surface, the skin over them is not discolored. They are almost constantly associated with endocarditis or with pericarditis, and when abundant and frequently recurring imply a progressive cardiac affection.

Among disorders we frequently meet with in the rheumatism of childhood is *tonsillitis*. It is often antecedent to the rheumatic attack or occurs in its course, and is combined with decided rise of temperature and pain in swallowing. It is not followed by either ulceration or suppuration.

The *anæmia* that attends the rheumatism of childhood is very pronounced, and persists long after the attack. Where successive rheumatic seizures occur it becomes more and more decided, and is often associated with marked irritability of the nervous system and emotional disturbance. In its persistence it may become a factor in the mischief wrought by a heart disease and in the development of dropsy.

Diagnosis.—The diagnosis of acute rheumatism in a child is more difficult than in an adult, because the joint affection is often very slight, and may be nothing more than mere stiffening attended with moderate fever, or pain in moving certain muscles and tendons. Under these circumstances we have to lay great stress on the family history, on the character of previous seizures, on the occurrence of attacks of tonsillitis. Signs of endocarditis or pericarditis, or pleurisy, or erythematous rash, or nodules, would be conclusive. In some instances, too, epistaxis, an occasional symptom of the rheumatism of childhood, is very significant; so is chorea. Endocarditis or pericarditis in a doubtful case would be, however, the most certain of proofs.

When the joint affection is distinct, scarlatinal rheumatism is the disease most likely to be confounded with ordinary acute rheumatism. As regards the symptoms I know no difference; heart affections in scarlatinal rheumatism are less common, but they arise. I have sometimes thought the absence of sweating diagnostic, but the acid sweats of rheumatic fever are also often absent in the rheumatism of childhood. Nothing but the antecedent history makes the case absolutely certain. The severe pain and the swelling

of the joints sometimes observed in cerebro-spinal fever may cause this to be mistaken for rheumatism. But the violent headache, the retracted head, the rosy or petechial eruption, the irregular temperature and pulse, are very different from the combination of symptoms noticed in rheumatic fever. In its earlier stages rickets may mislead, on account of the swelling near the joints, the pain, the sweats, the fever. Yet the absence of redness of the joints, the size of the epiphyses, the undisturbed heart, the cachexia, the pale urine, and the fact that the wrist-joints are apt to be the ones first disturbed, or that the swelling shows itself chiefly on the dorsum of the foot and on the back of the hand, are full of significance.

From pyæmia, rare in children, rheumatism differs by the irregular fever of the former, the sweats, the great pain and swelling that are found in only one or in a few joints, and the course of the disease. There is a pyæmic arthritis to which infants are liable, that Townsend has well described, which runs an acute course, is mostly confined to the hip or knees, and in which the effusion speedily becomes purulent. Its occurrence in infants at the breast or when gonorrhœal ophthalmia or vaginitis is present also distinguishes it.

Scurvy may present pain and swelling of the joints; the absence of fever and the condition of the gums tell us that it is not rheumatism. In congenital syphilis the state of the bones near the joint may lead to the thought of rheumatism, but the characteristic eruption, the snuffles, the emaciation, the enlargement of the spleen, the rarity of fever, and the fact that the symptoms arise in early infancy are diagnostic.

The diagnosis of the most dreaded affection in rheumatism, the endocarditis, presents the same points for consideration as it does when it is not of rheumatic nature, and is discussed in another part of the volume. I will only here mention how important it is to remember the anæmic state that rheumatism develops in the young, and not to regard every murmur arising in its course, and especially when it has nearly run its course, as organic and as likely to lead to permanent valve-injury. These soft, systolic blood-murmurs are unconnected with change in valve or in muscular texture, and gradually pass away.

Course and Duration.—The course of acute rheumatism in childhood depends very much upon the complications, especially upon the cardiac lesions. Nor do we find as many frank cases running their course in a definite time; the cases are mostly subacute, with subsidences and fresh outbreaks. On the other hand, in infants there are instances of very rapid progress. Jaccoud's cases in infants soon after birth terminated, one in eight days, the other in little more than two weeks. As a general rule, the rheumatic fever of childhood lasts between two and three weeks. Slight cases, Steiner estimates, get well in from ten to fourteen days. Goodhart's results in ten cases, of which he stated that the longest duration was four days, is not the general experience. It is difficult to be precise in this matter of duration, since much depends upon how early the patient has come under treatment and how well he responds to treatment. Under the salicylates we see the duration often much abridged, in instances particularly of joint affection without internal lesions. Where the heart is affected the case frequently runs on for five or six weeks. Frank relapses are not common. But a succession of subacute attacks in rapid succession, affecting the joints but slightly while adding to the mischief in the heart, is not uncommon.

Prognosis.—This is favorable; few die in the disease. Certainly this is true of the first attack; if the attacks be repeated, there is much more danger during the acute seizure. And the danger, again, depends rather upon the

condition of the heart than upon the mere recurrence of the rheumatic fever. The liability to cardiac disease increases with the number of attacks. Yet this does not always happen. I have mentioned a case in which three severe attacks happened without heart implication; and A. Clark tells of one in a boy of twelve in which eight attacks occurred, the heart remaining sound. Such instances are, however, very exceptional. Age has something to do with the prognosis. Of cases between one and ten years of age, 83 per cent., McPhedran calculates, have heart lesions; between ten and twenty, 69 per cent. In 54 fatal cases of rheumatic heart disease Sturges encountered none under two years of age; 42 out of the 54 happened between six and twelve years. Embolism and thrombosis are rare, but very grave.

The chief concern where cardiac affections exist is as regards the amount of mischief that will remain after the acute symptoms have subsided. A murmur indicative of mere roughening of the valve may in the course of a few months disappear. But very often it persists, and gradually, if the lesion have been more than mere roughening of the valve, the signs of hypertrophy with dilatation become manifest. This may not happen from the first attack; but during slight recurring rheumatic seizures—slight at least so far as the joints are concerned—the heart affection is little by little added to; or this is aggravated by a more severe attack, in which a fresh extensive endocarditis occurs. From pericarditis we may have the same consequences as in adults—adherent pericardium with hypertrophy or dilatation; considerable effusions are very rare. Rheumatic pericarditis by itself has a better prognosis, both at the time and in its ultimate consequences, than endocarditis. But with reference to the latter it must be borne in mind that it is mostly associated with some pericarditis, really an endo-pericarditis; for few are the cases where endocarditis of rheumatic origin alone exists. Persistent anæmia after rheumatic endocarditis or pericarditis is always a bad sign. The hypertrophy or dilatation, which under any circumstances happens more rapidly in children than in adults, gains at increased rate. The frequent occurrence of fibrous nodules is a sign of danger, as fresh mischief is apt at the same time to be wrought in the heart. It is then here, as it is throughout in acute rheumatism, the heart, after all, that chiefly determines the prognosis. Chorea is rarely a serious complication. The joint affection mostly passes off completely; rheumatic thickening and ankylosis are very seldom seen in childhood.

Treatment.—The treatment of acute rheumatism in a child is the same as in the adult. The greatest care must be taken to keep the patient at rest and from being chilled, and with this view the child should be kept in bed in a flannel night-dress or between blankets. The diet should be at first chiefly farinaceous, with bread and moderate amounts of milk; later in the disease broths and fish may be allowed. Of medical remedies, the most prominent is salicylic acid or its compounds; among these, salicylate of sodium or of ammonium is well adapted. The dose to a child five years of age is thirty to forty grains in divided doses in twenty-four hours; to a child of ten, sixty to eighty grains. It may be given in syrup of orange, or in simple syrup with spirits of lavender. The salicylates relieve the joint affection and the pain, and their action is rapid; after the third or fourth day the dose may be diminished one-half or more. If no result be seen from them in three or four days, they are not likely to produce any, and some other remedy had better be administered. Nor ought they to be trusted to where heart complications exist. Further experience, indeed, both in children and in adults has only added to my conviction, expressed some years since, that the salicylates neither prevent pericarditis or endocarditis, nor benefit its course after it has set in. Their

chief use is where there is much pain and the joint affection decided; and it is always well in any case to give also alkalies from the start. When the circulation becomes depressed, or buzzing in the ears or giddiness occurs, the salicylates should be at once discontinued. Salicin is by some recommended as less objectionable, in doses of from five to eight grains every third or fourth hour to a child of five, after the salicylates have been administered for a day or two, or even from the beginning.

Under any circumstances, in instances of heart complication or where a heart lesion has existed from a previous attack, the alkalies are vastly preferable remedies. It is, indeed, to decided doses of the alkalies that we must trust. Fifteen to twenty grains of bicarbonate of sodium in simple syrup and mint-water every third or fourth hour to a child eight or ten years of age, or two drachms of the acetate of potassium in divided doses in the twenty-four hours, form the proper average dose. These alkalies should be administered until the urine becomes alkaline or neutral, and then enough be ordered to keep it neutral.

Quinine is very valuable. It may be given in decided doses when the temperature tends to run high, as, however, it is not apt to do in children unless there be endocarditis or pericarditis. In doses of about six grains daily to a child five years of age it is an excellent remedy when the more acute symptoms have subsided, whether the alkaline or the salicylate treatment be the one pursued.

Opium is another remedy of great value. It allays restlessness and pain and procures sleep. In coexisting endocarditis or pericarditis it may be directed in small, continuous doses, and is indispensable. The bromides relieve restlessness and excitability, and are not without influence on the course of the disease. Conjoined to chloral, they give rest at night; and Goodhart lauds the combination of five grains of the bromide of potassium and one or two of chloral as almost a specific for the nightmare of rheumatism in young children.

The treatment of the main internal lesions, the endocarditis and the pericarditis, is discussed in another part of this volume. I will only here speak of my favorable experience in pericarditis with brandy or whiskey in decided quantities, and with opium. The pleurisy is treated as all pleurisies are; the iodides are especially applicable to the plastic form. The salicylate of sodium has been recently highly spoken of in this kind of pleurisy; I have had no experience with its use. In the tonsillitis of rheumatism the salicylates give quick results.

The local treatment of rheumatism consists in wrapping the affected joints in cotton wool, or, where they are very painful, in a flannel bandage saturated with a solution of nitrate of potassium, one to two drachms to the ounce, to which laudanum, twenty drops to the ounce, has been added. For lingering swelling of the joints the rubbing in of iodine, ten to twenty grains to half an ounce of lanolin and half an ounce of belladonna ointment, is well adapted. During convalescence iron is strongly indicated; and there should be then, as always in rheumatic children, the greatest care exerted with reference to warm clothing, to the food being of easily digestible kind, and to the avoidance of exposure to cold and damp as well as to fatigue and over-exertion.

II. Muscular Rheumatism.

This is met with in children, as it is in adults, mostly following cold and exposure, especially exposure to draughts, or fatigue. The disorder is generally subacute, and attended with but little constitutional disturbance. The prom-

inent symptom is pain in moving the parts involved. It is very rarely a general disorder, but is limited to particular groups of muscles. We find it in the deltoid; or in the muscles of the loins, as lumbago; or giving rise to stiff neck, as torticollis; or involving the intercostal muscles and restricting the acts of breathing, as pleurodynia; or in the muscles of the head, as cephalodynia. Wherever it is, it has the same characteristics—pain on motion, slight tenderness, little if any fever. Not unfrequently the urine is high-colored and full of urates.

Diagnosis.—In the diagnosis of the affection we have to distinguish it from neuralgia. The stricter limitation of the pain of neuralgia to particular spots, and its passing along special lines of nerve-distribution, the far less influence motion has on it, form, broadly speaking, the traits of distinction. We must also not be misled in considering as muscular rheumatism "growing pains," or the pains of aching muscles after unusual exercise.

Prognosis.—The prognosis is always favorable. The main object, when the immediate attack has been remedied, is to prevent recurrences.

Treatment.—Rest of the affected muscles, the application of warmth by hot fomentations or the hot-water bag, the use of liniments containing chloral, chloroform, or opium, are all beneficial. Atropine and morphine hypodermatically, so valuable in adults, cannot be so generally employed in children. Diaphoretics are always serviceable; a combination of nitrate of potassium and Dover's powder is eminently so; and in lingering cases the bromide of ammonium or the iodide of potassium or of ammonium is of distinct benefit. So is the continuous current. Jacobi considers that the best preventive is the habitual use of cold water.

III. Chronic Rheumatism.

Chronic rheumatism, as we see it in adults, is rare in children; certainly long-continued stiffness of muscles and chronic enlargement of joints are rare. As already pointed out, recurrence of short attacks with stiffness and pain is the form in which the persistency of rheumatism in childhood much more generally shows itself.

The few cases that present the same appearances noticed in the chronic rheumatism of adults may be mistaken for rheumatoid arthritis—a disease which is not unknown in childhood, though it is rarely spoken of. The previous history of the case, the occurrence of rheumatoid arthritis in those of feeble health, the wasting of the muscles, the enlarged, crepitating, or fixed joints with the gradually developing characteristic distortion of the fingers and toes, and the absence of all tendency to cardiac affection, are significant in the distinction.

In the treatment of chronic rheumatism the chief remedies are the iodides, the muriate of ammonium, and arsenic, with great attention to general health and thorough protection by dressing warmly. Using iodine to the affected joints or rubbing them with ammoniated liniments, or, if there be effusion or bony thickenings, small blisters applied from time to time, will give the best results. Good is also done by massage, and by warm baths with carbonate of sodium dissolved in them, or by a recourse to the sulphuretted and alkaline mineral-water springs that have been found to be of real service in the chronic rheumatism of adults.

PART V.

DISEASES OF THE BLOOD.

ANÆMIA, SPLENIC ANÆMIA, LYMPHATIC ANÆMIA, AND LEUKÆMIA.

BY FREDERICK A. PACKARD, M. D.,

PHILADELPHIA.

WHILE in most respects the blood of infants and children resembles that of adults, there are in the blood of the new-born a few variations from the adult standard which require mention.

During the first twelve days of life the blood has a somewhat venous appearance when seen in bulk.

In the new-born child the red blood-corpuscles are of much more unequal size than they are in older children and in adults, the largest of them being larger, and the smallest, smaller. During the first four days of life there are to be found a varying number of nucleated red cells. These soon disappear, although some observers claim that they are to be found up to the second or third year.

Owing, presumably, to the ready solubility of the hæmoglobin in young infants, numerous "shadows," or red blood-cells that have lost their hæmoglobin, are present. The red cells are more easily affected by reagents than is the case in adults, moisture in particular causing them to very readily assume the spherical form. The number of red cells is proportionally larger in the newly-born, the count varying, according to different observers, from 4,300,000 (Bouchut, Dubrisay) up to 7,500,000 (Gundobin) per cubic millimetre. The daily variations in their number are very marked.

There is marked increase in the number of colorless blood-cells in young infants as compared to adults. The subject of the relative number of the different forms has been most carefully studied by Gundobin (*Jahrb. f. Kinderheilk. u. phys. Erziehung*, Bd. xxxv. Hft. 1 and 2, Jan., 1893). According to this author, the relative percentage of lymphocytes in sucklings is three times as great as in adults, while the neutrophiles are relatively twice as small in number. From the seventh to the tenth day is the period at which the relative and absolute numbers attain the proportions maintained in later life.

The amount of hæmoglobin is greater in young infants than in adults. This relative increase is maintained for some weeks, at the end of which time it begins to diminish, until at about the middle of the first year it has reached its lowest point, thereafter slowly increasing to the normal of adult life.

The specific gravity is said to be high immediately after birth (1.066), but it soon sinks to a little below that of adult blood.

PLETHORA.—It is now granted that, while this term may be used as a convenient means of describing certain conditions, it is not accurate, in so far as

it implies an actual increase of the total mass of blood or of its corpuscular elements. The term was employed to indicate a condition formerly supposed to be due to "full-bloodedness," but now known to be a condition wherein the appearance of vascular turgescence is due not to any over-richness in blood, but to local changes in the superficial vessels. That a relative increase above the normal of the number of red blood-corpuscles can exist is true only in conditions where the watery constituents are decreased, as in cholera. To this condition the term "plethora" is manifestly inapplicable, the loss of fluid merely increasing the number of corpuscles in the drop.

ANÆMIA.

Anæmia is a condition of the blood due to a decrease in its richness in either corpuscular elements or hæmoglobin, either from primary disease in the blood-making or blood-destroying organs, or, secondarily, from general or local disease that interferes with normal absorption, metabolism, and assimilation, or is productive of abnormal loss of nutritive material from the body.

In the above definition anæmia is spoken of as a condition instead of as a disease, since in the vast majority of instances it is merely a symptom of some well-recognized disease of the whole body or of individual organs. The anæmias produced by morbid processes that are recognizable as distinct diseases are spoken of as secondary, whereas those occurring without apparent cause save disease of the blood-making or blood-destroying organs are spoken of as primary. In the latter class we must still place chlorosis, progressive pernicious anæmia, splenic anæmia, lymphatic anæmia (Hodgkin's disease), and leukæmia.

SECONDARY ANÆMIA.

Etiology.—Our knowledge of the process of blood-formation and blood-destruction is not sufficiently advanced to explain the production of anæmia in all cases in which it occurs. Where actual escape of blood from the blood-vessels takes place, the explanation is, of course, manifest; but it is far from evident in exactly what manner prolonged high temperature, loss of albumin from continued suppuration or Bright's disease, the rheumatic poison, and certain toxic influences produce decrease in the richness of the blood in corpuscles or hæmoglobin. In childhood the chief causes of secondary anæmia, aside from those operative equally in adult life, are due to improper hygiene as to diet, exercise, and ventilation. A frequent cause is mucous disease, which seems to act by preventing the proper digestion, absorption, and assimilation of nutritive material. Improper articles of diet and improperly prepared food may act in practically the same way; that is, by a failure to supply nutritive material proper to the needs of the body. Too rapid growth is capable of causing anæmia, the frame seeming to outgrow the quantity of blood manufactured, just as it is apt to become too large for the functional capacity of certain organs. In addition, we must recognize the fact that in some individuals a condition of anæmia seems to be a constitutional characteristic, and to be not incompatible with a fair degree of health. Malaria, as a cause of anæmia, seems to act with even greater intensity in children than is the case in adults, while the anæmia of acute rheumatism at times reaches an extreme grade. Further than in these respects the secondary anæmia of childhood differs in no way etiologically from that in adult life.

Symptoms.—The general appearance of a child with simple anæmia is too well known to require description. The white skin, pallid mucous membranes, waxy appearance of the nails, and blueness of the white of the eye are seen in children as plainly as in adults, if not more so. The subjective symptoms of anæmia do not attain much prominence in childhood, as not only is the child less well able to express its sensations than is the adult, but also because it simply ceases to play around or to exert itself when it feels the subjective sensations produced by anæmia, instead of being compelled, as is the adult, to struggle against discomfort in the endeavor to continue the duties of life.

One of the most frequent symptoms observed in children is the tendency to syncopal attacks. These may occur apparently causelessly, or may be readily induced by violent emotion, slight pain, or confinement in a poorly ventilated apartment. Shortness of breath upon exertion is also frequently present, although in children too young to feel the stimulus of competition this may be shown merely by an indisposition to exertion. Rarely, except in cases of extreme degree, is any œdema discoverable.

The hæmic murmur at the apex or base does not seem to be produced in children so readily as is the case with adults.

The examination of the blood shows a reduction in the red blood-corpuscles, with a corresponding diminution of hæmoglobin; that is to say, the *valeur globulaire* does not differ from the normal. In extreme cases poikilocytosis may be observed. A relative increase of white blood-cells as compared to the red may be present, owing to the reduction in number of the latter.

Diagnosis.—There is, as a rule, no difficulty in determining the existence of simple anæmia, but the diagnosis cannot be considered as complete until the cause of the poverty of the blood has been detected. The question of the causative factor in simple anæmia of the young requires not only a careful examination of the child itself, but a minute scrutiny of all of the hygienic surroundings.

The differential diagnosis between simple, secondary anæmia and that of chlorosis and of pernicious anæmia is readily made by an examination of the blood. In simple, secondary anæmia blood-corpuscles and hæmoglobin are reduced together, and to an almost equal extent, whereas in chlorosis the hæmoglobin reduction far exceeds that of the corpuscles, and in progressive pernicious anæmia the corpuscular poverty exceeds that of hæmoglobin. From splenic anæmia the diagnosis must be made by the detection of a cause other than the enlarged spleen.

Prognosis.—This depends entirely upon the cause. The anæmia itself rarely reaches a degree sufficient to cause anxiety.

Treatment.—While removal of the cause, when possible, is the prime object of treatment, we may frequently combine our symptomatic treatment of the anæmia with the hygienic and medicinal treatment of the previous affection. Good, nourishing food in quantity and quality to suit the age of the patient and the condition of the digestive organs, abundance of fresh air, and an amount of exercise adapted to the primary disease and to the strength of the patient are all-important aids in treatment.

For the purpose of increasing the richness of the blood in corpuscles and coloring matter we have two drugs upon which reliance can be placed, iron and arsenic. In employing iron it is important to remember its marked tendency to interfere with digestion, and in cases dependent upon gastro-intestinal disturbances we can frequently increase the lacking blood-elements more rapidly by first correcting the digestive troubles, when, indeed, the iron may not be

required at all. The best forms for its administration to children are the syrup of the iodide of iron, reduced iron, or one of the vegetable salts of iron. The dose of whatever preparation may be selected should be carefully regulated to the age of the patient, and the drug should be discontinued or its amount lessened when it produces constipation or when the stools are distinctly darkened. In this form of anæmia it is unwise to give more iron than can be absorbed and utilized, whereas in chlorosis even the iron that is voided with the fæces seems to have been of some utility.

Arsenic is of great value as a restorer of the red corpuscles, probably by its action upon the blood-making organs. It is pre-eminently useful in the anæmia of chronic malarial poisoning, and is of marked value in the later treatment of mucous disease with anæmia. It is often well to combine iron and arsenic, as they seem to virtually assist each other in many cases; some such form as the following may be employed:

℞. Liquor. potassii arsenitis . . . . . fʒj.
Syrup. ferri iodidi . . . . . fʒix.—M.
Sig. Ten drops thrice daily.

THE PRIMARY ANÆMIAS.

Chlorosis.

While essentially a disease of youth as opposed to childhood and infancy, this disease is occasionally met with before the former period of life is reached. It is therefore proper that it should find a place in a work upon pediatrics.

Etiology.—While much has been written upon the essential cause of this condition, it cannot as yet be said that the etiology is by any means definitely settled. The theories regarding it are too numerous to be even enumerated. The most satisfactory explanation is that the excessive destruction or imperfect formation of hæmoglobin is due to either the defective absorption and assimilation of iron from the intestinal tract or to the absorption from the bowel of poisonous principles with hæmolytic properties. The view advocated by Virchow that it is caused by congenital hypoplasia of the vascular system, and the view that it depends upon developmental imperfection of the genital apparatus, cannot be considered as tenable considering the rapid and complete cure following the employment of proper hygienic and medicinal treatment.

Age is an etiological factor of great importance, most of the cases occurring between the thirteenth and twentieth years of life. Instances have been observed, however, in individuals even below the former age.

Sex has a strong determining influence, the vast majority of cases occurring in females, and but light grades of the affection being seen in boys. Heredity cannot be said to have any but a predisposing influence, and even that is doubtful, although Trousseau and others claim that the disease is very frequent in tuberculous families.

Habits of life play an important part in its production, the overworked with but little opportunity for the enjoyment of fresh air, exercise, and mental relaxation being those most frequently affected. Depressing emotions, sexual abuse, and fright seem to act as causes, either directly or remotely. The menstrual disturbance so frequently seen in connection with this particular alteration in the composition of the blood must be looked upon as a result rather than as a cause.

Symptoms.—The complaint that induces a patient with chlorosis to seek

medical advice is variable. Sometimes it is the shortness of breath upon exertion, at times the interruption of the menstrual periods, and at times the cephalalgia. The usual history given is that the patient has suffered from vertical headache for a variable time, with shortness of breath upon exertion, palpitation, marked lassitude, and frequent fainting-spells. The date of appearance of the several subjective sensations is as variable as is their relative intensity. The symptoms above enumerated are those most constantly present. Constipation is usually marked, and a desire for unnatural articles of diet is at times a prominent feature. Gastralgic attacks are frequently present.

The appearance of the patient is extremely characteristic. The skin has a peculiar olive tint, which, taken in connection with the pale lips, is imitated by no racial peculiarities of coloring. There is apt to be a certain ashy appearance about the angles of the mouth. The expression is usually languid with an appearance of sadness, while the features frequently show some heaviness of outline. There is a variety of chlorosis, first described by Wendt, wherein the cheeks retain an abnormally red color—*chlorosis florida seu rubra*. Occasionally a deposit of pigment in the neighborhood of joints is observed. The mucous membranes are pallid to a varying degree according to the extent of the anæmia. There may be slight puffiness beneath the eyes, and the feet or ankles may show slight œdema with but little pitting upon pressure. Marked œdema is, however, rare. There may be visible pulsation of the vessels of the neck. The subcutaneous fat is seldom decreased; in fact, the condition of *embonpoint* is that most frequently seen. The pulse is usually rapid and compressible. The apex-beat of the heart is usually plainly visible, and more diffuse than in health. Auscultation reveals, in all marked cases, a soft blowing murmur at either the apex or base, or both, with sharply-defined and somewhat valvular first sound. Over the veins of the neck there is almost always to be heard a loud venous hum. Thrombosis is apparently rather favored by the condition of the blood.

The examination of the blood is of itself sufficient for a diagnosis. The characteristic change is a marked decrease of the percentage of hæmoglobin. With a corpuscle count of 4,500,000, or even over 5,000,000, per cubic millimetre the hæmoglobin may be decreased to 50 or 40 per cent. of the normal. Less characteristic appearances are the pallor of the drop as it flows from the finger and the variety in the size and shape of the red blood-cells when seen through the microscope.

The genital apparatus is usually said to be undeveloped. I have, however, seen within the past year a chlorotic, aged fifteen years, with mammæ, areolæ, and nipples of the size and appearance of those seen in adult life. The urine presents no changes of note save in that it is of low specific gravity and pale in color, contrasting strongly with the low specific gravity and dark color of the urine in cases of pernicious anæmia. Albumin in small quantities is occasionally found.

Morbid Anatomy.—There have been no distinctive lesions found in the few fatal cases that have come to autopsy. The narrowness of the arteries with the small size of the heart noted by Virchow, and the presence in some cases of a poorly-developed uterus and its appendages, are all that have been noted aside from the apparent bloodlessness of the organs and the retention of a fair amount of adipose tissue. In some cases the left ventricle has been dilated. No alterations in the blood-forming organs have been reported.

Diagnosis.—As has been said, the appearance is characteristic. The tint of the skin is quite different from the yellowish-brown stain of jaundice and from the lemon-yellow tint of pernicious anæmia and the cachexiæ. The

sclerotics are of a clear blue color, in contradistinction to the yellowish coloration of icterus.

From these as well as other diseases the blood-examination will separate this affection at once. From pernicious anæmia and Bright's disease the absence of retinal disturbances would readily distinguish it; while in the former the examination of the blood is as characteristic as it is in chlorosis, and in the latter the presence of tube-casts and absence of oligochromæmia are points of plain significance.

Prognosis.—The outlook is extremely favorable, providing only that patients can be persuaded to continue treatment until absolute cure is established. The tendency to relapse is very marked, and patients frequently cease their visits when their most marked symptoms have been relieved, only to return in their former condition after the lapse of a few weeks. The disease is but very rarely fatal, and the unfavorable result is due to the onset of some incidental affection. The only complication of note is gastric ulcer, and this is seen but rarely. Permanent disease of the heart may result in protracted cases.

Treatment.—This is most satisfactory if the patient persist in treatment until cure is complete.

Hygiene plays an extremely important part. Plenty of fresh air, with moderate exercise and a plain but nourishing diet, will do much to hasten the cure. In some cases absolute rest in bed with milk diet seems to act well, particularly in the more severe and obstinate cases.

The daily use of the flesh-brush upon rising in the morning is of value, not only in relieving the coldness of the extremities that is often present, but in improving the general nutrition. In vigorous subjects cold sponging before breakfast will help to increase the general tone of the system. The bowels must receive careful attention. Daily evacuations should be procured by regulation of the diet, the use of "cannon-ball" massage to the abdomen, and, if necessary, by the use of tonic laxatives. Of the latter, the best by far is aloës or aloin. The latter may be made up into a pill with extract of nux vomica and extract of belladonna, and should be taken at bed-time. The pill of aloës and myrrh of the United States Pharmacopœia is an excellent combination for older subjects.

The specific remedy for the disease is iron. The simpler the form in which it is given, the better. The most satisfactory is in the combination known as Blaud's pill (℞. Ferri sulphat. exsiccat., Potas. carb. (pur.), *āā* gr. iij). This may be given after meals, increasing from one to three times a day, to two pills three times daily in the first ten days, and maintaining or even increasing this number until the hæmoglobin has reached the normal amount. Where objection is made to taking pills, as is frequently the case among the class in which this disease is most prevalent, powdered iron may be readily given. The great point is to give the drug steadily and unremittingly until the oligochromæmia has been absent for one or two weeks or even longer.

Progressive Pernicious Anæmia.

This is an intense, generally progressive, alteration of the blood arising spontaneously, characterized clinically by the symptoms and signs of marked anæmia, by diminution of the number of the red blood-corpuscles without corresponding decrease in the amount of hæmoglobin, and by an almost invariably fatal result.

The name of this condition must be looked upon as being provisional. It

is probable that in the future some more definite knowledge may be obtained that will enable us to separate the cases now grouped together under the above title into separate classes depending upon etiological factors that are at present unknown. Formerly cases were grouped under this title that are now known to be separate pathological processes, of which the anæmia was merely a symptom, notably those of atrophy of the gastric mucosa and those due to intestinal parasites. At present, however, we must include under one name a class of cases that have no apparent causation in organs other than those immediately concerned in blood-formation, and which still present a uniform grouping of symptoms.

Etiology.—The actual cause of this disease is as yet unknown. The researches of Quincke and Peters upon the excess of iron found in the liver of patients dying of it, and the observations of Hunter upon the dark color of the urine from the presence of pathological urobilin, would point to the existence of some cause for an increase of hæmolysis. Whether this be a poison created within the body has not as yet been proven, but from the remarkable resemblance between this and the anæmia from atrophy of the stomach it is at least possible to suppose that the hæmolysis may be produced by the absorption of some toxic principle from some portion of the alimentary tract.

Age is a marked etiological factor, inasmuch as the large majority of cases occur during middle life. That it does occur in young persons with moderate frequency is shown by the fact that cases have been collected by Griffith,[1] wherein the disease has occurred at the ages of sixteen months, three, five, seven, eight, ten (2 cases), eleven (2 cases), twelve, fifteen, and eighteen years, and in one other boy in which the age was not given; while I have found additional cases reported as pernicious anæmia, without an exhaustive search of the literature, at ages of eleven months,[2] one year and four months,[3] two,[4] four,[5] eleven (2 cases),[6] thirteen,[7] fifteen,[8] sixteen,[9] seventeen,[10] and twenty[11] years.

The female is rather more prone to the disease than is the male sex.

In one of Escherich's cases the appearance of the disease followed close upon vaccination with animal lymph, but whether there was any relation between the two events it is impossible to say.

Symptoms.—The most striking subjective symptom is extreme and progressive weakness. Shortness of breath and vertigo soon become prominent symptoms. While feeling extremely ill, the patient retains a fair amount of fat, and save for extreme pallor has the appearance of a well-nourished individual.

The weakness and pallor increase gradually with, at times, temporary short intervals of apparent improvement. Dyspnœa increases, the extremities become œdematous, and the patient is at length compelled to remain in bed,

[1] Keating's *Cyclopædia of Diseases of Children*, 1890, vol. iii. p. 809.
[2] D'Espine and Picot (*Revue de Méd.*, 1890, p. 859): blood-count not given, doubtful.
[3] *Ibid.*: blood-count not given, probably a true case.
[4] Escherich (*Wiener klin. Wochenschr.*, 1892, No. 13, p. 193).
[5] Mott, *Practitioner*, Aug., 1890.
[6] Ashby and Wright (*Diseases of Children*, 1892, p. 337): no blood-count, urine of low spec. grav., and pale, therefore doubtful.
[7] D'Espine and Picot (*loc. cit.*): no blood-count given.
[8] Taylor (*Guy's Hosp. Rep.*, 1878): doubtful, no blood-count.
[9] Wilks (*Guy's Hosp. Rep.*, 1857, p. 203): probably a case of pernicious anæmia, though described as a case of "idiopathic fatty degeneration."
[10] Handford (*Br. Med. Jour.*, 1891, p. 445).
[11] Roosevelt (*N. Y. Med. Record*, 1888, p. 407).

the whole body being sometimes water-logged with anasarca. Occasionally irregular elevations of temperature arise without apparent cause. Gastro-intestinal disturbance may be present, but in cases unassociated with gastric and intestinal atrophy they sink into insignificance in comparison with the intense languor and shortness of breath. Hæmorrhages from the mucous membranes and beneath the skin are sometimes present and may be profuse.

As a result of treatment or without apparent cause, the condition may for a time improve, but the course is usually progressively downward until death occurs from simple asthenia, possibly hastened by an attack of intestinal disturbance or by the onset of some acute inflammatory trouble.

The appearance of the patient is almost pathognomonic. The skin is of a peculiar pale-lemon tint, the lips almost white, the conjunctivæ of a pearly whiteness. Areas of pigmentation may be present on various parts of the body. The retention of a fair degree of *embonpoint* with the extreme pallor at once suggests this disease to one who has seen a case thereof.

Upon physical examination nothing abnormal may be found save soft hæmic murmurs at the apex or pulmonary cartilage and venous murmurs in the neck. The pulse is soft, readily compressible, and gives an impression to the finger similar to that of aortic regurgitation, which disease this also somewhat resembles in the occasional presence of a capillary pulse. The urine is peculiar in that with low specific gravity the color is quite decided—due, according to Hunter, to the presence of pathological urobilin. Upon ophthalmoscopic examination streaks of hæmorrhagic extravasation are frequently to be seen.

The examination of the blood is of itself sufficient to determine the diagnosis. The blood as it exudes from the finger is usually of a paler color than normal, and may be obtained only with great difficulty. Upon examining a fresh specimen there is found to be extreme irregularity in the size and form of the red cells. There are seen in the same field numerous red cells smaller than the normal, side by side with others of double the size of the latter. Nucleated red cells of large size are also seen. There is little tendency to the formation of rouleaux. The red blood-cells are far below the normal average per cubic millimetre. Their number varies much with the duration and severity of the individual case: it may sink to below 500,000 per cubic millimetre. The estimation of hæmoglobin shows that this is in excess of the amount corresponding to the cellular reduction. This disproportion of the number of red cells and the amount of hæmoglobin is characteristic of the disease—the *valeur globulaire* is exceedingly high.

Morbid Anatomy.—The skin is generally of a markedly yellowish-white color. The subcutaneous fat is usually remarkably well preserved and is of a light-yellow color. The muscles are peculiarly red, in marked contrast with the pallor of other tissues and of the muscular tissue in other forms of anæmia. All of the internal organs look blanched, but upon the various serous membranes ecchymotic areas are frequently seen. Punctiform hæmorrhages may also be present in the skin, mucous membranes, connective tissue, muscles, heart-wall, bone-marrow, lymph-glands, spleen, liver, pancreas, lungs, and dura mater. They are due, according to Bermer, to fatty degeneration of the capillaries, although other observers have failed to find the change described. In the serous cavities a varying amount of clear serum is present. The heart is usually large and soft, its walls flabby, its chambers almost empty of blood. "Tabby-cat mottling" of fatty degeneration is frequently present, or the whole tissue may be pale and fatty-degenerated. The spleen shows no constant changes. The gastric mucosa may be found atrophied in some cases of appa-

rently true idiopathic pernicious anæmia; but these cases should not be classed under the name of the disease under consideration unless the view that atrophy of the gastric and intestinal glands is one of the results thereof. The liver is fatty, and shows the only really characteristic change of any of the organs. Upon microscopic examination there is found an excess of free iron in the cells of the outer and middle zones when the sections are treated with proper reagents. The kidneys may be the seat of marked fatty degeneration, and iron has been occasionally detected in the renal cells. The marrow of the shaft of the long bones is of a deep brick-red color, resembling the fœtal condition, but the appearance is not characteristic, as it has also been found in other forms of anæmia. In the posterior columns of the spinal cord there has been found a process resembling in every respect that seen in locomotor ataxia.

Diagnosis.—The chief difficulty in diagnosis lies in the exclusion of a primary cause for the anæmia. The appearance of the patient, the subjective symptoms, and the progressive course will usually lead to a correct diagnosis. An examination of the blood definitely decides the question. The diseases which most resemble pernicious anæmia are atrophy of the gastric tubules and malignant disease of the internal organs, particularly those of the digestive tract. Careful examination will usually exclude the latter even without an examination of the blood. Certain cases of atrophy of the gastric tubules have so resembled pernicious anæmia as to render a distinction between them an impossibility. Unfortunately, in these cases the chemical examination of the gastric contents is of but little aid, as Ewald has found that hydrochloric acid is absent from the gastric juice in pernicious anæmia as well as in gastric atrophy, and the peptonizing power is diminished in both conditions.

Prognosis.—The outlook is extremely grave. As a rule, death comes in spite of all our efforts. A fatal result occurred one month after the first appearance of pallor in the two-year-old child reported by D'Espine and Picot, and in Kjellberg's case of a boy aged five years death occurred six weeks after development of symptoms. Recovery may be considered impossible if the red cells number 500,000 per cubic millimetre or less. Since the discovery of the value of arsenic in this disease the prognosis is somewhat less hopeless than formerly. By its use apparently hopeless cases may be at least temporarily relieved. Too often, however, the improvement is but temporary, and relapse soon takes place. Death comes from exhaustion or from the onset of some intercurrent disease. A sharp attack of diarrhœa or an inflammatory disease of the respiratory tract is frequently the immediate cause of death. Hæmorrhage is rarely of sufficient amount to cause death. Litten reports a case that apparently passed into leukæmia.

Treatment.—Absolute rest with freedom from worry and excitement is of prime importance. A diet selected with care and adapted to the needs and capacity of the individual is to be directed.

Among drugs none can equal arsenic in value. By its means the number of red blood-cells may be increased to within a fair degree of normal, and with corresponding amelioration of symptoms. It should be given freely up to the point of tolerance. It is better to begin with small doses well diluted, and to increase as rapidly as is consistent with the avoidance of toxic symptoms: upon the appearance of gastro-intestinal disturbance or of œdema either the use of the drug should be entirely discontinued for a time or the dose should be much reduced. The pigmentation occasionally seen in the course of the disease should not cause needless fear of arsenical pigmentation. Iron is but seldom of value. It may, however, be used in cases showing an intolerance to arsenic. Rectal

injections of blood prepared in various ways are no longer considered worthy of the hope that was at one time placed in them.

The inhalation of oxygen may relieve the dyspnœa that is at times severe, but nothing more than palliation can be expected to result from its use.

If the theory of intestinal absorption of ptomaïnes in the causation of this disease be correct—and there seem many reasons for believing it to be so—rendering aseptic the intestinal canal would be a rational means of cure. It is well, therefore, to keep the bowels opened regularly, and to administer in appropriate quantities salol, thymol, or β-naphthol in order to accomplish what we can in this direction.

Splenic Anæmia.

In a considerable number of children there is found a marked degree of anæmia associated with no appreciable lesion save enlargement of the spleen. Rendu has reported a case wherein, after the lapse of two years, an increase in the number of white blood-corpuscles occurred, and Gilbert saw a case that later was transformed into lymphatic leukæmia.

Etiology.—Much discussion has been indulged in as to the cause of this form of anæmia in childhood, and even now it cannot be said that any uniformity of opinion has been obtained. Malaria is certainly capable, when long operative, of producing both anæmia and chronic splenic enlargement in children, just as in the case of adults. The cases presenting a malarial history comprise, however, but a very small minority of the cases in which this affection has been observed.

The two diseases that appear to have most claims as etiological factors are rickets and inherited syphilis. Out of 30 cases, Carr found 27 with other distinctly rachitic lesions; in 14 cases syphilis played at least a prominent part. In 60 rachitic children Kuttner found a palpable spleen in 44, in 33 of which the organ was markedly enlarged. In only 2 of the 60 cases was there a clear history of syphilis, but in 13 there was a history that the mother had had miscarriages or stillbirths. In 63 cases examined by them, Fox and Ball found that rachitic symptoms were present in almost all; and in one series of 105 consecutive cases of rickets the spleen was enlarged in 14 per cent.; in another series of 84 cases of very marked rickets, enlargement was present in 40 per cent. That inherited syphilis may be more than a predisposing factor is rendered highly probable from further statistics furnished by the last-named authors. In 63 cases of enlargement of the spleen with anæmia they found inherited syphilis in 41 per cent.; while in 155 cases of inherited syphilis the spleen was enlarged in 48.4 per cent. The influence of hereditary syphilis in causing rickets should not be overlooked, and it seems more than likely that the most potent factor is rickets. It is interesting in this connection to learn that Sutton (according to Fox and Ball) has found both liver and spleen constantly enlarged in monkeys, where rickets is produced by causes other than syphilitic taint.

The disease would appear to be frequently found in members of the same family, partly due, no doubt, to the fact that the individuals were all subject to the same conditions of life.

Boys are more often affected than girls, Kuttner having found it in 37 boys out of 60 cases. The disease has been seen at the age of two months (Carr) and in adult life, so that no definite statement can be made as to age as a predisposing factor.

Pathological Anatomy.—The only characteristic lesions found relate to the spleen. The organ is enlarged, the capsule thickened and adherent, the

parenchyma firm, with marked increase of fibrous tissue. The microscopic examination shows increase of fibrous tissue, with atrophy of Malpighian bodies and disappearance of adenoid tissue (Peter). The marrow of the long bones may have become lymphoid in character. In the other organs various changes are to be found as coincidental affections. These are practically the lesions discovered after death in children with rickets or inherited syphilis. The most frequent abnormal conditions found relate to the respiratory organs. There may be bronchitis, atelectasis, pneumonic consolidation, or the deposition of tubercles. The gastro-intestinal tract may show the lesions of a chronic catarrhal inflammation.

Symptoms.—Lassitude and general weakness on the part of the child may be the causes of medical treatment being sought. In other cases the peculiar pallor may have called the attention of the parents to the child's condition. The enlarged spleen may have caused anxiety, or the child may have been brought for treatment on account of the catarrh of the respiratory or digestive tract that is a frequent accompaniment of the condition. The existence of the disease may be discovered accidentally in examining a child presenting other manifestations of rickets. The complexion is of a peculiar waxy, pallid hue, with rather a muddy tint. The mucous membranes are blanched, the tongue pale and flabby.

Upon examination of the trunk there are found in rachitic children not only the prominent abdomen that is usually seen in children of this class, but there may be visible tumor in the hypochondriac and lumbar regions of the left side. Frequently the enlargement of the spleen may not be discovered until palpation reveals a resisting mass. In marked cases the spleen can be readily felt as a sharply-defined solid tumor, with its anterior edge notched in one or two places. The organ can be made more prominent by pressure with the free hand upon the left hypochondriac and lumbar regions. In less well-marked cases careful palpation, with firm pressure upon the left flank, may be required in order to bring the anterior edge forward sufficiently to be felt through the abdominal wall. Testi heard a vascular murmur over the enlarged spleen.

Examination of the blood reveals a reduction in the number of red corpuscles. Kuttner found the number in 10 cases to vary from 1,020,000 to 4,080,000, with a hæmoglobin value of 35 per cent. in the former instance and 73 per cent. in the latter. There is no absolute increase in the number of white blood-corpuscles, although in fatal cases there may be at times an increase in these elements toward the close of life.

Irregular fever is frequently present, possibly owing to the frequent catarrhal complications. In some cases epistaxis may be present, in some subcutaneous hæmorrhages. Albuminuria seems to be rare, although Carr found it present in two of his cases. The liver is frequently enlarged, and there may be some enlargement of the deeper sets of lymphatic glands. Catarrhal inflammation of the bronchial mucous membrane and in the gastro-intestinal tract is frequent, but it is impossible to attribute it to the condition of splenic anæmia, owing to the frequent coexistence of the rachitic condition.

Diagnosis.—When the spleen is much enlarged the history of the case and the examination of the blood render the diagnosis a matter of ease. The absence of increase of white blood-cells would differentiate the disease from splenic leukæmia, and an examination of the blood for the plasmodium malariæ would cast out malarial enlargement. From enlargement of the spleen from amyloid infiltration the absence of a history of the influences causative of that affection, and the failure of evidence of a similar infiltration of the liver and

kidneys, would differentiate this disease. From an enlarged left kidney the diagnosis is to be made by the presence of notches in the anterior border, by the direction of enlargement, by the greater motility of the tumor upon bimanual examination, and by the absence of urinary changes. The acute enlargements from typhoid fever, embolic abscess, and acute malarial poisoning are readily excluded by the history of the case. Enlargement from cirrhosis of the liver would be but little apt to cause embarrassment in arriving at a diagnosis.

Prognosis.—While fatal cases are not rare, the prognosis is not, as a rule, bad if proper hygienic conditions can be enforced. Of Carr's 30 cases, 10 died, 6 disappeared from sight, 13 recovered, and 1 remained stationary. The chief cause of death is the occurrence of acute respiratory or digestive inflammatory complications.

Treatment.—Of prime importance is the securing of proper hygienic surroundings. Plenty of fresh air, well-ventilated sleeping apartments, and a proper amount of outdoor exercise are essential. The diet must receive careful attention. The food should be plain and nourishing, with absence of excess of farinaceous articles. The clothing also should be regulated.

Of drugs, cod-liver oil, arsenic, and iron are the most useful. Phosphorus may be used in those markedly rachitic. In cases that have a distinct history of inherited syphilis mercury may be given, but even in the manifestly syphilitic the splenic enlargement is apt to undergo no diminution from its use. The judicious administration of cod-liver oil by either internal means or by inunction, or by both methods combined, with the use of a combination of iron and arsenic, such as was mentioned in the section upon Secondary Anæmia, will be found to be the best line of treatment in connection with careful correction of insanitary conditions.

The application of electricity over the spleen may produce lessening in the size of the organ.

Lymphatic Anæmia.

This affection is a more or less generalized condition of the lymphoid tissue of the body, characterized by enlargement of groups of glands or increase in the normal lymphoid structures of a part, accompanied by oligocythæmia and a varying amount of enlargement of the spleen.

The disease bears in many respects a close resemblance to the lymphatic form of leukæmia, and, in fact, the leucocytosis that frequently is present to a marked extent has been seen to pass into a condition of true leukæmia. The whole subject of the relation between these two diseases of the lymphoid tissues of the body, and also between them and diffuse sarcomatous disease of the lymphatic glands, still needs further study, in spite of the work that has already been done in attempting to assign them to their proper position.

Etiology.—This is still far from decided. Inherited syphilis has been supposed to play a certain rôle, but it is doubtful whether the association has been more than a coincidence. Age certainly exerts some influence, as the disease is very common in the young. Males are more frequently attacked than females. Heredity has not been shown to exert any influence. The action of continued local irritation or inflammation would seem to be a strong etiological factor, and it may be owing to the frequency of long-standing lesions of the skin, of the face and head, of the jaws and ears, that the cervical chains so frequently are the earliest and most markedly involved groups.

Symptoms.—The disease begins insidiously with enlargement of some group of lymphatic glands, with increasing anæmia with its accompanying

subjective symptoms, and with progressive weakness. The glands most frequently attacked are those in the posterior cervical triangle, but the axillary or inguinal glands may be first involved. Deeper sets of glands, as those in the thoracic or abdominal cavities, may be involved before the external tumors appear, or even without involvement of the superficial groups. The external glands may form large masses, producing much disfigurement. The cervical glands may obliterate the outlines of the neck or may encircle the front portion of the neck like a collar, and produce marked dyspnœa. The axillary group may be enlarged sufficiently to prevent the apposition of the arm to the side, while the inguinal glands may enlarge sufficiently to embarrass locomotion. Pressure of these masses may produce various secondary results, such as pain radiating down the trunks of the nerves running near to the tumors, and œdema from pressure upon the venous trunks. When the visceral sets of glands are involved, there may be no outward signs of their presence, although the retroperitoneal and mesenteric groups may be enlarged so much as to be both seen and felt. By pressure upon various organs, blood-vessels, or ducts they may produce effects varying with the part involved. Dyspnœa may be produced from pressure upon the bronchi; cyanosis or œdema of the face from pressure upon the superior vena cava. Dyspeptic symptoms, constipation, anuria, ascites, and œdema of the lower extremities may be caused by enlargement of the groups within the abdominal cavity. Secondary involvement of the spinal cord may produce paraplegia from pressure.

The lymphoid tissue in the tonsils, tongue, pharynx, skin, and intestinal wall is occasionally the seat of the same outgrowth, producing symptoms varying with the situation involved.

Either continued mild pyrexia, alternating periods of pyrexia and apyrexia, or distinctly intermittent fever is usually present during some period of the course.

The general symptoms are those due to the anæmia. Vertigo, headache, lassitude, and dyspnœa may be obtrusive symptoms. The patient is usually very pale, and the white skin with thickened neck forms a picture that could with difficulty fail to suggest the presence of this disease.

The examination of the blood shows a decrease of the number of red blood-cells to a varying degree. Poikilocytes are common, and nucleated red blood-corpuscles are occasionally seen. There is leucocytosis, which in some cases attains to such a degree that the case must be classed as a lymphatic leukæmia.

The patient usually succumbs after a period varying from less than a year to five years (Gowers) from asthenia. Obstinate diarrhœa may occur at any time, even without involvement of the intestinal canal. Death may occur from pressure upon the air-passages before the general condition of the patient would excite alarm.

Morbid Anatomy.—The skin is pale, the subcutaneous layer of adipose tissue more or less decreased. The post-mortem findings vary much in different cases in accordance with the glands involved. Usually there are masses of enlarged superficial glands in the neck, axillæ, or groins. These are found to be composed either of isolated, enlarged nodules varying from the size of a pigeon's egg to that of a hen's egg, or of masses of lymphatic glands welded together or even infiltrating neighboring structures, from which they may be separated either with difficulty or not at all. Upon section the individual glands present various appearances even in the same case. They may be soft and of a color not differing much from the normal, and may yield an abundant milky juice, or they may be hard and firm, showing a clear white color of the cut surface without any juice.

Any of the lymphatic glands in various parts of the body may be involved in the same way. The groups of glands in the mediastina, the bronchial glands, the retroperitoneal, or the mesenteric, may each or all of them be enlarged and more or less matted together. The thymus gland has been found either uniformly enlarged or the seat of lymphoid tumors.

The spleen is enlarged in the great majority of cases, either from simple hypertrophy or from the presence of tumors of lymphoid tissue. The liver and kidneys may show nodules of lymphoid tissue. The lungs are sometimes affected from encroachment of growths from the bronchial group of glands or by the growth of independent foci of lymphoid tumors. The heart rarely shows similar growths in its substance.

Various secondary morbid changes are produced by the pressure of the masses of glands upon neighboring structures.

The marrow of the long bones may have a puriform appearance or may be of an intense red color.

Histologically, the lymphoid tissue of the enlarged glands and of the isolated tumors is found to be composed of a delicate reticulum enclosing round cells. In some glands there is also an increase of fibrous tissue.

Diagnosis.—In many cases it is impossible to state whether the case in hand should be classed as one of pseudo-leukæmia or as a true lymphatic leukæmia. In the latter disease the spleen more frequently attains a considerable size than in the cases now classified as pseudo-leukæmia. As this disease may pass into a true leukæmia, in so far as the blood-estimation forms a criterion, and as the treatment is practically the same for the two affections, the differential diagnosis makes but little practical difference. The name "pseudo-leukæmia" should, however, be applied only to those cases wherein the proportion of white to red cells does not exceed one to thirty.

From tubercular adenitis, the so-called scrofulous enlargement of the glands, the differential diagnosis must be based partly upon the family and past personal history, partly from the appearance of the patient, but chiefly from the more localized character of the glandular swelling and the tendency to caseation and suppuration in the tubercular disease.

Secondary involvement of the lymphatic glands by cancer will not enter into consideration in those below adult life.

Prognosis.—The outlook is extremely unfavorable. The progressive tendency of the disease may sometimes be combated by treatment, but cure can be expected but rarely. In the early stages, where the involved glands are accessible to the surgeon, the disease may be cured by operative treatment. The degree of asthenia and the extent of the anæmia offer some means of forming a prognosis as to duration.

Treatment.—In early cases, where superficial glands are alone attacked, the chance of cure by surgical means should not be neglected. In cases of doubtful nature, where the diagnosis between this affection and an essentially local disease of the affected glands is difficult, the safest course is to avail ourselves of surgical means of cure. Of drugs, arsenic is the only one upon which dependence can be placed. It should be administered in ascending doses until the point of tolerance is reached. Iron is of secondary value as a hæmatonic, but may be combined with arsenic, preferably in the form of the officinal syrup of the iodide of iron. External applications to the affected glands can only be of value where the integrity of the skin is in danger.

Tracheotomy may be necessitated by pressure upon the trachea or if the enlarged glands interfere with the nerve-supply of the vocal cords.

LEUKÆMIA.

Leukæmia is a disease of the blood-making organs, characterized, clinically, by the symptoms of anæmia, excessive increase in the number of white blood-cells, and a tendency to hæmorrhagic extravasation; pathologically, by enlargement of the spleen and lymphatic glands and by changes in the bone-marrow, either separately or in combination.

The condition of the blood in this disease is mimicked in health after eating (physiological leucocytosis) and in various organic diseases wherein there is an intense local lesion (pathological leucocytosis), as in pneumonia, empyema, etc. The term "leukæmia," however, must be limited to cases wherein leucocytosis is more or less constant, is of marked degree, and is associated with the characteristic lesions of spleen, lymph-glands, or bone-marrow.

As to the nature of the disease there is much diversity of opinion. The term "leukæmia" is at present the most applicable, because non-committal, name that we can apply to it.

Various divisions have been made in respect to the part chiefly or solely involved in the disease—splenic, lymphatic, or medullary (myelogenous). Rarely is any one form present alone, but the cases usually fall into the classes lieno-medullary or lieno-lymphatic. Cutaneous, intestinal, and tonsillar forms are curiosities.

The disease bears, in many respects, a close resemblance to sarcomatosis.

Etiology.—The precise etiology of the disease has not yet been decided. It is preceded by malaria and syphilis in a number of cases sufficient to render it possible that these diseases have at least a predisposing influence. Trauma in the splenic region has been followed by its appearance. Some of the more acute cases pursue a course that is strongly suggestive of an infectious origin. Fermi, Powlowski, Bonardi, Kelsch and Vaillard, Klebs, Roux, and others have reported the finding of various micro-organisms in the blood or tissues of cases of the disease. Negative results were reached in Westphal's case in an attempt to obtain cultures from the spleen during life and from the blood and bone-marrow after death. Gilbert unsuccessfully attempted to inoculate healthy dogs with lymphatic glands from a dog affected with the disease. Mosler failed to produce the disease by the injection of leukæmic blood into dogs and rabbits. Bollinger met with a similar result in attempting to produce the disease in healthy animals by the injection of blood from leukæmic animals of the same species. Apparent infection occurred in Obrastzow's experience, where an attendant upon a case died after fourteen days' illness with purpura, hæmorrhages, fever, albuminuria, and a proportion, in the blood, of one white to nine red blood-cells.

The disease is seen at all ages from birth up to the seventy-fifth year. It is most frequent between the ages of thirty and fifty years. It is not rare in childhood, many cases having been reported in infants less than two years of age, while Sänger has reported its existence in a stillborn child. It is more common in males than in females. Heredity has not been proven to be an etiological factor. Horses, oxen, dogs, pigs, cats, and mice suffer from a similar affection.

Symptoms.—The usual symptoms that impel the patient to seek advice are the general weakness, the pallor, the shortness of breath, hæmorrhages from the mucous membranes, the enlargement of the abdomen, or the superficial lymphatic tumors. The disease usually arises gradually, so that, as a rule, marked changes in the organs and blood have occurred before the patient is brought for treatment.

The symptoms produced by the abnormal condition of the blood are similar in the different forms of the disease, but the examination of the patient yields results varying with the type. Breathlessness upon exertion is usually a very marked feature. It may be accompanied by marked vertigo upon change of posture. The bodily strength is impaired to a great degree, but in some cases it is remarkably well preserved in view of the serious changes in the composition of the blood. Hæmorrhages may have occurred from the nose, throat, stomach, or intestines, or there may be hæmorrhagic extravasations beneath the skin. Hæmorrhages in the fundus oculi may produce sufficient interference with vision to attract the attention of the patient. Edes has recorded a case wherein priapism was the first symptom. During the course of the disease occasional rises of temperature may be noted.

Upon examination there is found more or less pallor of skin and mucous membranes. The pulse is soft and compressible, with increased rate. If the anæmia be marked, there may be heard a hæmic murmur over the position of the apex-beat or in the second left intercostal space. The lungs usually present no morbid signs save toward the close of fatal cases, when œdema, congestion, or a fluid accumulation in the pleural cavity may be found. In some cases there is found in the lung what clinically resembles lobar pneumonia, but histologically is found to present features differing from the ordinary form.

Diarrhœa may be persistent, and in some cases a species of dysentery is present. Vomiting is not a frequent symptom. The occasional occurrence of hæmatemesis has been mentioned above.

The urine is usually unaltered save for an increase in the amount of uric acid excreted.

On the part of the nervous system we may have no symptoms. Vertigo and cephalalgia are at times marked. Death may occur from intracranial hæmorrhage. Vision may be much impaired, due to the presence, as revealed by the ophthalmoscope, of retinal hæmorrhages or of leukæmic deposits. Hearing may be impaired. Suchamick has noted a peculiar brownish discoloration of the nasal mucous membrane in one case.

The usual course of the disease is slowly progressive, covering a period of months or years. There have been reported some cases running an extremely rapid course, as in that of Guttmann, where a fatal termination occurred after an illness of four and a half days.

The examination of the blood is all-important in determining the nature of the disease. The constant feature is an increase, both relative and absolute, of the white corpuscles. This may attain to an extreme degree, the relative number of white to red cells having even been as two to one in a case reported by Robin. The average ratio of white to red cells is as one to fifty or twenty, in cases without great reduction in the latter elements, as opposed to one to 500 or 700, the average ratio of health. The various forms of white blood-cells are present in different proportions in the lieno-medullary and in the lymphatic varieties. In the former the eosinophilous cells of Ehrlich are the predominant form, whereas in the acute lymphatic variety the lymphocytes form the main proportion of the colorless elements. Where the lymphatic, splenic, and medullary varieties exist together in the same patient, the proportion of the forms of leucocytes will produce variations from the two types mentioned. Myelocytes may be present in large numbers. Charcot's crystals are said to form after the blood has remained upon the slide for a short time.

In the splenic form a prominent feature is the gradual enlargement of the spleen. This occurs to a varying degree, the organ in extreme cases even

reaching to or beyond the median line of the abdomen. The splenic enlargement takes place chiefly in a diagonal direction, downward and toward the right. When the hand is placed over the mass, a rub may be felt and tenderness be elicited by pressure. Spontaneous pain or sense of pressure may be an annoying symptom, while the weight of the organ may produce disorder of digestion or marked constipation.

When the marrow of the bones is affected, there may be tenderness over the affected parts, with localized swellings on the shafts of the long bones or the ribs or sternum.

The lymphatic glands are less frequently involved than is the spleen. The superficial glands show enlargement and can be readily felt, or even seen as isolated groups or chains. The deep glands of the abdominal cavity may be affected.

Morbid Anatomy.—The skin is pale, the subcutaneous fat usually much diminished. The blood has a chocolate color, or may even almost resemble sanious pus. When clotted it has a greenish-yellow color. On the serous membranes there may be areas of hæmorrhagic extravasation. In the serous cavities there is usually an excess of fluid.

The heart is frequently found distended with clotted blood. The lungs present no constant changes, although posterior congestion is often seen. Rarely are there any changes in the thymus gland.

The spleen is almost invariably enlarged to a greater or less degree. Adhesion to neighboring organs is common, explaining the sharp attacks of pain sometimes experienced in the left hypochondriac region. The organ is usually symmetrically enlarged, is of increased density, and on section may show either a brownish color throughout the surface, or there may be scattered areas of a white color due to localized infiltration with lymphoid cells, either in the Malpighian follicles or in the pulp. Hæmorrhagic areas may be present. The spleen may enlarge so rapidly as to cause a rupture of its capsule.

The intestines show at times evidences of lymphoid infiltration, either in the glands of Peyer or in other parts, by thickening without ulceration. The tonsils, pharynx, and stomach have been found to show signs of the overgrowth of lymphoid tissue.

Lymphoid tumors have been found in the liver in sufficient number to notably increase the size of the organ, while the kidneys also may present whitish areas of lymphoid infiltration, as in the case reported by Fränkel. The lymphatic glands of the superficial sets or of deeper parts, as near the root of the mesentery, are in some cases much enlarged, although rarely to so great an extent as in pseudo-leukæmia.

The marrow of the bones is affected in a considerable number of cases, chiefly in conjunction with splenic involvement. In these cases it is found to be of a puriform appearance or to be of a dark-red color. Hæmorrhagic areas may be present. The shaft may be found expanded and the wall thinned. Microscopically, the marrow shows large numbers of nucleated red blood-cells, eosinophiles, and myelocytes.

Diagnosis.—The only diseases with which leukæmia is apt to be confounded are pseudo-leukæmia, splenic anæmia, and scrofulosis. From these the diagnosis may readily be made by an examination of the blood. The numerical increase of the white blood-cells is alone sufficient to make the diagnosis, save in cases of non-leukæmic leucocytosis. From this the diagnosis cannot be made with certainty by the hæmocytometer alone, as in leucocytosis the relative increase of white cells may be greater than in some cases of leukæmia. For the differentiation of these two conditions we may employ the

method of differential staining according to Ehrlich's procedure. While some question has been raised as to the value of the eosinophile cells as diagnostic criteria, this objection cannot now be said to be of weight save in the lymphatic variety, where the cells having eosinophile granules are not present in large number.

Prognosis.—The prognosis as to recovery is grave, although cases have been known to recover. The disease is usually fatal within a few years. In some cases of acute lymphatic leukæmia, as in the case reported by Guttmann, death may occur within a few weeks or days.

Treatment.—Rest is of prime importance. The dietary should be selected with care, and should be suited to the digestive power of the individual.

Arsenic is almost the only drug that can be said to be of any real value. It should be pushed up to the verge of tolerance, and its use should be persisted in until either it is evident that no result is being obtained or until the patient is, mayhap, relieved of the disease.

Quinine should be tried in cases giving a malarial history, but it will rarely be productive of much benefit.

Injections of arsenic into the spleen are not likely to materially benefit the patient, and are not without risk. Westphal's case died after a puncture of the spleen for diagnostic purposes, the organ being surrounded by a large blood-clot at the autopsy. Splenectomy cannot be considered justifiable, in spite of Franzolini's successful case, in view of the large mortality attending the operation.

HÆMOPHILIA.

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Hæmophilia is a tendency to obstinate bleeding; inherited; often associated with swelling of the joints.

Etiology.—The hæmorrhages may be traumatic or spontaneous in origin. Certain families are known as "bleeders," the hæmorrhagic diathesis manifesting itself at any time from early infancy to the end of life. Hereditary transmission takes place mostly through the mother and to her male offspring. If a woman descended from bleeders marry a healthy man, the sons will inherit the hæmorrhagic diathesis, the daughters escaping. In the succeeding generations the sons in whom hæmophilia is manifest will not transmit the diathesis, whereas the daughters, who show in themselves no signs of it, will transmit the diathesis again to their sons. The maternal transmission so continues to many generations, the hæmorrhagic condition appearing in the males, the females escaping, but transmitting the diathesis to their sons. Bleeders usually have large families, some of whom may escape the disease. They are to be found in all localities, in all conditions of life; are healthy in appearance, commonly having fine, soft skins. The Hebrew race is said to be particularly liable to it.

The real cause of hæmophilia is unknown. It is believed that the condition has in some individual instances been acquired.

Pathological Anatomy.—The post-mortem findings do not explain the nature of the affection. An unusual thinness of the walls of the vessels has been observed, though the microscope fails to reveal any essential and constant alterations. The tissues are blanched from loss of blood. Petechiæ and bruised patches are frequently observed upon the surface of the body. The swelling of the joints is due to hæmorrhages into the articulations and the surrounding tissues. Occasionally there is evidence of joint inflammation. At present it has not been determined whether the hæmorrhage is due to some fault in the walls of the vessels, or whether there is some peculiarity in the character of the blood on account of which thrombi are not formed.

Symptoms.—At birth there is nothing in the appearance of the child to indicate the peculiarity of his inheritance. He is usually healthy and bright, and may in the first year develop no signs of hæmophilia. The severing of the umbilical cord does not usually give occasion for obstinate bleeding, and not until his growth and strength lead him into accidents, such as bruises, cuts, scratches, and punctures, does the hæmorrhagic tendency become apparent. Epistaxis is the most common experience which calls attention to the diathesis. This may be acute, obstinate, and alarming. Besides, there may be petechiæ, ecchymoses, hæmatomata, interstitial and external bleeding, traumatic or spontaneous.

A common symptom is swelling of the joints closely resembling rheumatism. It is not uncommon to find hæmorrhage of the gums at the eruption of the second crop of teeth. Slight cuts give rise to troublesome hæmorrhage, slight

blows to marked ecchymoses, and a blister may contain blood instead of serum. Prolonged and dangerous bleedings may follow the extraction of a tooth in spite of the application of the strongest styptics.

The bleeding is from the capillaries, most often an oozing, which may continue from hours to weeks. The subjects of hæmophilia are very sensitive to cold, and suffer from joint-pains apart from those dependent upon hæmorrhage. Such patients pass through the exanthemata and other diseases of childhood without special dangers, and have no marked proneness to phthisis. Sloughing and gangrene are not uncommon accidents of this condition.

Prognosis.—From the nature of the disease it must be considered a constant menace to life. However mild the tendency in the infant, the prognosis should be considered very serious. Of 152 cases of hæmophilia traced by Grandidier, more than half died before completing the seventh year, and only 19 attained majority. The exhaustion of repeated hæmorrhages, or, more commonly, the draining away of blood by continued oozing, may destroy life. The most difficult of control and the most frequently fatal are the hæmorrhages following extraction of teeth or from epistaxis.

There are examples of bleeders who have attained a good age and led busy lives. To this class belongs a very busy practitioner of the writer's acquaintance, who is never without fresh petechiæ of the face, and constantly carries a large red handkerchief for accidental epistaxis.

In females the prognosis is good, neither menstruation nor childbearing being complicated by this capricious example of atavism.

Treatment.—Prophylaxis avails somewhat to diminish the accidents of hæmorrhage. The system may be fortified by abundant fresh air and tonics, by judicious exercise and general hygiene. The child should be guarded, so far as possible, from bruises, cuts, and punctures. Vaccination, though not historically accounted a dangerous procedure in bleeders, should be accomplished rather by scarification than by incision. Slight operations should be seriously considered before they are undertaken, and every needed means of hæmostasis should be at hand. The extraction of teeth should be avoided. Nearly every practitioner has had at least one trying experience with obstinate hæmorrhage from such cause in a person not hæmophilic, and can well understand the importance of this advice.

It is well to have the diet properly regulated for hæmophilics, giving vegetables and generally wholesome mixed meals, without excess of meat. The bowels should be regulated so as to correct any tendency to a "full-blooded" condition. Where premonitory symptoms indicate an impending hæmorrhage, it is well to relieve the bowels by a mercurial purge, followed by a saline.

In case of hæmorrhage treatment will necessarily be modified by the region in which it takes place. Cuts and bruises should be cleansed and bound up, with ice, perchloride of iron, or nitrate of silver applied to the point of bleeding. In epistaxis the nasal cavities may be treated by irrigating the parts with cold water or by an absorbent-cotton plug saturated with peroxide of hydrogen; if need be, the cavities may be tightly plugged with cotton soaked in an iron solution. If the hæmorrhage arise from the socket of an extracted tooth, apply crystals of subsulphate of iron or a cotton pledget soaked in Monsel's solution, or apply caustics. Hæmorrhages from the bowel should be treated with opium to secure quiet and rest, and by cold-water injections.

Hæmophilics should be dressed warmly, should avoid cold, damp climates, and all so-called rheumatic surroundings. The joint affections may be treated much like similar conditions in chronic rheumatism, perfect rest and soothing applications being primarily indicated.

PURPURA HÆMORRHAGICA.

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Under the term "Purpura Hæmorrhagica" we include a clinical group of cases characterized by the association of purpura with hæmorrhages from any of the mucous membranes, less frequently into serous membranes and joints or into the substance of the viscera. First described by Werlhof in 1775, it is often known as "Werlhof's disease." It is also known as "morbus maculosus."

A careful study, however, of the cases embraced by this definition shows such a variety in their clinical course and in their etiological factors that it seems impossible to regard them even as different types of the same disease. Their symptoms, in a general way, may be alike, but in some cases they appear suddenly and peracutely without assignable cause, associated with symptoms of acute sepsis, often causing death within a few hours or days. In other cases without known cause the symptoms appear subacutely, and are less marked, the constitutional symptoms being mildly septic in character. In still others the symptoms occur either as a complication of some coexisting disease or as the result of a well-known cause. It seems better, therefore, to regard the term purpura hæmorrhagica as one purely clinical in its scope, including a number of cases distinct in their clinical course, pathology, and etiology, but which present, in common, symptoms of sufficient similarity to be included under one general name.

The study, then, of purpura hæmorrhagica is rendered more clear by dividing the cases of this disease into two groups: I. *essential*, and II. *symptomatic purpura hæmorrhagica;* the *essential* group including those cases in which the disease begins without known cause, the hæmorrhages and purpura being associated with more or less marked septic symptoms, and running a course resembling that of an infectious disease; the *symptomatic* group including those cases in which the symptoms arise from a well-known cause (as poisoning from over-use of potassium iodide), or as a complication of a severe blood or infectious disease (as in profound anæmia or in the exanthemata).

The essential cases seem to the author to constitute the only true group to which the term purpura hæmorrhagica should be rightly applied, and these will therefore be described more fully than the symptomatic cases, which should more properly be classed among the symptoms of the diseases which they complicate.

I. Essential Purpura Hæmorrhagica.

This form occurs both *subacutely* and *acutely*, the former being far the more common, and about which we know most.

Subacute Purpura Hæmorrhagica.

This variety of the disease is seen more frequently in females than in males. While no age is exempt, it usually attacks children and young adults. Food deficient in quantity and quality, poor hygiene, and a weak, sickly constitution predispose to the disease, but not as markedly so as in scurvy. Often it attacks those who are healthy, well fed, and well housed. There is rarely a family history of any hæmorrhagic disease, although in two cases in young girls under the author's observation the father of each had been subject to severe attacks of epistaxis in early life. The subacute cases occur in two clinical forms: (1) *ordinary cases*, and (2) *cases of Henoch's disease.*

Ordinary Subacute Cases.—This form usually begins with prodromal symptoms, anorexia, malaise, chilly feeling, and irregular rise in temperature, especially at night. These may precede the onset by several days or even weeks. In other cases there is no prodromal period. When the disease is fairly developed we have both hæmorrhagic and constitutional symptoms.

Symptoms.—*Hæmorrhagic Symptoms.*—There appear purpuric spots, usually first noticed on the extremities, though they may be generally distributed. Their size varies from that of a pinhead to that of the palm of the hand. In severe cases we may have large areas of ecchymoses, which may be extensive enough to cause gangrene of the skin. Successive crops of purpura appear during the disease, and they may be often produced by rubbing or scratching the skin. Rarely we have associated with the purpura and ecchymoses hæmorrhagic vesicles and bullæ.

There are free hæmorrhages from any of the mucous membranes—nose, mouth, gums, bronchi, stomach, intestines, and pelvis of the kidney. There may be also metrorrhagia. The most frequent sources of hæmorrhage are from the nose, pelvis of the kidney, intestines, and uterus respectively.

These hæmorrhages occur spontaneously, and not from traumatism alone, as is the case in hæmophilia. They may be moderate in their severity or profuse enough to cause the death of the patient.

Pain and swelling of the joints, especially those of the hands, feet and knees, are frequently noticed. The symptoms are identical with those of purpura rheumatica. There may be swelling of the fibro-serous tissues about the joint, or the joint-cavity may be filled by an effusion either serous or fibrino-serous. In severe cases the joint may become ankylosed or an arthritis may be caused. The primary symptoms are due to hæmorrhages either into or around the joints.

Internal hæmorrhage may occur at any time and into the substance of any of the viscera, especially the brain and its membranes, the suprarenal capsules, or the lung. These internal hæmorrhages, however, are rare in the subacute form, though more common in acute cases.

The gums may be normal or swollen, although this is denied by many writers. They may be covered by blackish scabs, and may bleed even when they are not swollen. The teeth, however, are not loosened as in scurvy.

In no case are ulcers of the intestine, due to submucous hæmorrhages, ever seen. Free hæmorrhage from the skin does not occur. Although the kidneys are frequently the source of hæmorrhage, nephritis has not been observed.

Constitutional Symptoms.—These appear in varying intensity, and are due both to the anæmia from the hæmorrhage and also to moderate sepsis. A distinct chill at the onset is rare, but chilly feelings are common and may continue through the attack. The temperature varies from 100° to 103°, or even 104°, being higher in severe cases and in children. It is higher at night. After the

severity of the attack is over the temperature gradually returns to normal: a sudden fall in temperature, with a subsequent rapid rise, is noted in cases of sudden severe hæmorrhage, especially if such occur into the viscera.

The pulse is of low tension and somewhat rapid. It may become rapid, small, and weak. Attacks of syncope are common.

General anæmic symptoms are always present, even in cases in which the hæmorrhages are slight, but they are more severe when the hæmorrhages are profuse. They appear early in the attack and continue throughout its duration; after the attack subsides the recovery is long and tedious, and often it takes weeks or months before the blood returns to its normal condition.

Examination of the blood during the attack shows rapid diminution of the number of red blood-corpuscles, and a corresponding diminution in the amount of hæmoglobin. The white cells are at first increased in number, as is the case after acute hæmorrhage, but later their number steadily diminishes, even during early convalescence, while the number of red corpuscles and the amount of hæmoglobin are steadily increasing.

These points are well shown by the records of blood-examinations made in a case reported by Osler:

	Number of red cells.	Number of white cells.	Per cent. of hæmoglobin.
1st day,	5,350,000 (107%)	8,000	95
2d day,	3,000,000 (60%)	12,500	50
8th day,	2,500,000 (50%)	12,500	37
14th day,	3,000,000 (60%)	7,000	47
50th day,	4,000,000 (80%)	2,500	62
70th day,	4,250,000 (82½%)	. .	72

Prostration is a prominent symptom, and is always more marked than can be accounted for by the hæmorrhage and constitutional symptoms. It remains usually for some weeks after all other symptoms have disappeared. In severe or long-continued cases it may be so profound that the patient passes into the "typhoidal condition," with rapid and feeble pulse, dry brown tongue, stupor alternating with mild delirium, or even coma and death.

The spleen and liver are usually enlarged during the attack. The enlargement of the liver in some cases is well marked, and may be distinctly appreciable for weeks or months after the subsidence of the disease. The congestion and enlargement of the liver often cause a mild catarrhal jaundice, which, added to the anæmic appearance of the patient, gives a bright fawn-yellow color to the skin.

The duration of the attack varies from a few days to several weeks, but the disease may be protracted for weeks, months, or years by the appearance of similar attacks (or "relapses" of some authors). These attacks may recur at regular or irregular intervals, their usual number being four or five. In one unique case under the author's observation the attacks have persisted for fifteen years, the patient showing no signs of improvement at the end of this time. The next case of longest duration is one reported by Hryntschak, in which the attacks lasted for seven years.

Nature and Pathology.—For the blood to escape from its vessels and cause hæmorrhage we must naturally conclude that the vessel-wall must first rupture. As this does not normally occur, except from traumatism, we must also conclude that its wall is weakened either from inflammation or from degeneration due to disease, to poor blood-supply, to toxic blood, or to thrombi.

Much light has been thrown on this subject by Silberman, who gave fifteen

dogs small steady doses of pyrogallic acid until there appeared areas of stasis in the small arteries, capillaries, and veins. After pressing out the stasis-blood he injected fibrin ferment into the arteries. The dogs had abdominal tenderness, purpura, bloody vomiting, and bloody stools. Autopsy showed in the hæmorrhagic areas thrombi in the small arteries and veins, whose walls had undergone hyaline degeneration with areas of necrosis, thus allowing the free escape of blood.

Many attempts have been made to discover a specific bacterium, but before the time of Letzerich the examinations were so incomplete as to be entirely without value. Letzerich, however, in 1889 made scientific bacterial examinations, and discovered a bacillus which he believes to be the specific germ of the disease. Although his experiments have not been corroborated by others, their success still remains of the greatest value. His patient was a girl suffering from the subacute form. Bacterial examinations, scientifically performed in every detail, showed in the purpuric spots the presence of long bacilli capable of growth in gelatin, the pure cultures of which, injected into the abdomen of rabbits, reproduced the original clinical symptoms in all of the twelve cases, and in these a bacillus was found identical with that in the pure culture injected. An examination of the purpuric spots in the rabbits showed dilatation of the capillaries, emigration of white cells, and rupture of the capillary wall, permitting the escape of red cells. The capillaries were filled with the bacilli with abundant spore-growth. (The bacilli and spores had been previously described by Petrone, in his examinations of a case of Werlhof's disease, but he considered the disease to be due to a mixed infection.)

Upon squeezing the section Letzerich found that little plugs resembling hyaline casts containing bacilli emerged from the capillaries, and these he considered the result of the action of the bacillus in its products upon the fibrinoplastic elements of the blood. The liver in the rabbits was regularly enlarged, and the portal capillaries were almost occluded by an extraordinary growth of the bacilli. Letzerich considers the liver to be the breeding-place of the bacilli, the liver being to this disease what the spleen is to malarial fever. If he be correct in his conclusions, it explains both the scattering of the lesions—a bacterial embolism of the capillaries causing hyaline thrombi within them with rupture of the capillary wall—and also the tendency of the disease to relapse. While conducting his experiments Letzerich was himself seriously attacked by this disease, attributing his infection to handling his cigar while at work. This case of infection seems to prove the advisability of disinfection after an attack.

Prognosis.—This is generally good, almost all patients recovering from the primary and secondary attacks. Recovery, however, is slow, the anæmia and prostration often lasting for months after the disappearance of other symptoms. The occurrence of the secondary attacks cannot be foretold. In rarer cases the disease terminates fatally, the cause of death being either profound anæmia, fatty degeneration of the heart, with or without dilatation, from long-continued anæmia, visceral hæmorrhages, or exhaustion.

Treatment.—This is unsatisfactory, both in shortening and mitigating the attack and in the prevention of subsequent relapses, as there is no specific known that acts in this disease as quinine does in malarial fever. Our treatment, then, must be entirely symptomatic, and consists in treatment during the attack and prophylactic treatment destined to prevent future attacks.

The treatment during the attack consists in efforts to check the hæmorrhage and in the relief of constitutional symptoms. To check the hæmorrhages no one drug is certain. We employ, in turn, a number, until we find

one that is efficacious, but we may run through the entire list of hæmostatics without result. The drugs which are most frequently used are aromatic sulphuric acid, ergot, turpentine, digitalis, quinine, and gallic acid. During a hæmorrhage the patient must be kept absolutely quiet, even if morphine be required for this purpose. In all cases and at all times care should be taken to guard against traumatism, over-exertion, and excitement. Alcohol and highly-seasoned food may also give rise to a hæmorrhage. Epistaxis may be checked by astringent sprays or by plugging the nares. Uterine hæmorrhage should be treated by firm tamponage.

If the joints be affected, salicylic acid is often of service. The pain may be relieved by anodyne applications, as lead-and-opium wash, ichthyol or iodine ointment, or by the application of heat and cold. Firm compression is often grateful.

Constitutional symptoms are treated on general principles. The patient must be put to bed and on a low diet during the attack. Later he may be about the room, and a more generous diet may be allowed, vegetables and vegetable acids and fruit being especially indicated. In all cases the patient should be kept quiet and free from excitement or exertion. The bowels must be kept open, and any digestive errors corrected. Should the pulse become rapid and feeble, cardiac stimulants are indicated, especially digitalis and strychnine. Alcohol in large doses should not be used.

During the close of the attack tonics are to be given, quinine, strychnine, and arsenic being the best combination. Iron is contraindicated, as, by experience, we know that its early administration may bring on a fresh attack.

If the anæmia be marked during the attack, arsenic is the drug most efficient. It is to be given in increasing doses to the point of tolerance, then stopping its use for a day or so, and then increasing its dose as before.

If symptoms of sudden profound anæmia occur, we apply warmth to the body, hot applications over the heart, and give cardiac tonics, especially opium in small, repeated doses. Inhalation of pure oxygen gas is of the greatest service. In severe cases we employ, in addition, rectal or hypodermatic injections of a warm sterilized saline solution. Several pints can be given in this way with great improvement of the symptoms, although this may be but temporary. Arterial transfusion is not to be used, because of the danger of traumatic hæmorrhage. Elevation of the foot of the bed and ligatures applied to the extremities are often followed by good results.

The prophylactic treatment employed during and after convalescence is intended to lessen the chances of subsequent attacks.

The patient must live and work in airy, sunny rooms and take graded exercise in the open air, for fresh air and moderate exercise are of the first importance. The plumbing must be in perfect sanitary condition. The diet should be wholesome and varied, and every digestive error corrected.

For the anæmia, arsenic in small continued doses is by far the best treatment. It should be continued until the blood becomes normal. It may be combined with quinine and strychnine. Iron is not to be used at first, but several weeks after the primary attack has subsided it should be given in small doses at first, then slowly increasing. Should a relapse threaten, the iron must at once be stopped.

Prostration is to be treated on general principles by rest, fresh air, graded exercise, and change of climate. The climate most suitable is one in which the air is light, dry, and bracing; and the location must be inland, as we find that the disease more extensively prevails on the sea-coast.

As the disease is probably due to an infectious specific germ, and as the sub-

sequent attacks are also probably due to reinfection, it seems certainly better to disinfect the room and the clothes of the patient after the illness. The more we study this disease, the more we incline toward such disinfection.

Henoch's Disease.—The severe form of the subacute cases was first described by Henoch, and is known as "Henoch's disease" or "Henoch's purpura hæmorrhagica." This form occurs with greater frequency in children, especially between the ninth and twelfth years. It has been observed, however, between the third and forty-sixth years. It occurs five times more frequently in males than in females. It is a rather rare form.

Symptoms.—There is usually a short prodromal period with malaise, slight fever, and sometimes with pains in the joints.

The onset is manifested by the appearance of purpura, in severe cases accompanied by ecchymoses, these differing in no way from those described under the first form. Immediately after the purpura, appear the severe abdominal symptoms which characterize the disease. There is marked pain and tenderness over the abdomen, the pain being of a colicky character, with exacerbations of great intensity. The abdomen is rigid and retracted. There is severe rectal tenesmus with bloody stools and severe vomiting, the vomited matter being either like that of acute gastritis or containing blood. These abdominal symptoms seem to be due to submucous hæmorrhages or to hæmorrhagic infarctions caused by thrombi in the small blood-vessels of the gastro-intestinal wall, which become degenerated and rupture, allowing free hæmorrhage. Patches of intestinal ulceration result in rare cases, and rupture into the peritoneal cavity with fatal peritonitis may occur even after apparent recovery.

These symptoms continue with great intensity for one or two days, and then gradually subside. They may continue longer, but in such cases there are periods of temporary improvement. Joint symptoms may appear as in the first form. Hæmaturia is seen in one-fifth of the cases. The spleen is usually enlarged, and there is a slight rise of temperature during the attack.

After such an attack the patient is liable to have a series of similar ones, usually at short intervals. There are generally four or five such, but their number has been recorded as high as twenty.

The nature of the disease is unknown. No specific micro-organism has as yet been found, but as the reported cases are few, it is possible that in time one will be discovered, either Letzerich's bacillus or some other bacterium producing the same results.

The duration varies according to the length of the attacks, their number, and the intervals between them. It is usually six to twelve weeks, but may be limited to a week or be extended to nine months.

Prognosis.—This is fairly good, being better in children (mortality, 5 per cent.) than in adults (mortality, 25 per cent.). The possibility of intestinal rupture and peritonitis, though rare, must be taken into account.

Treatment during an attack is purely symptomatic. Between the attacks we improve the general condition in every way.

Acute Purpura Hæmorrhagica

is far more rare than the subacute form. The same symptoms are present, but run an acute and more severe course, overwhelming the patient by their violence and the rapidity of their onset. The acute form differs, moreover, from the subacute in the severity of septic symptoms, in the frequency of visceral hæmorrhages, and its disposition to attack pregnant women. We can

broadly subdivide the acute cases into three groups: (1) cases with marked sepsis; (2) cases with visceral hæmorrhages; (3) cases complicating pregnancy.

1. Cases with marked Sepsis.—These present both severe hæmorrhagic and septic symptoms, but the latter are so predominant that the course of the disease is essentially that of acute septicæmia.

The attack usually begins by a chill or chilly feelings, with a rise in temperature to 103° or 104° F. Hæmorrhagic symptoms soon develop, purpura and hæmorrhages from any of the mucous membranes. These are severe, and are not readily controlled by treatment. Septic symptoms are marked from the onset—severe prostration, mental apathy, stupor, or semi-coma, alternating with periods of restlessness, anxiety, and mild delirium, and finally, in fatal cases, complete coma. The temperature remains high, 103° to 104°, but in severe cases it may rise to 105° or 106°. The pulse becomes rapid, feeble, and irregular; and the patient usually dies early in the disease, either from sepsis or from acute anæmia.

The following case, personally observed, illustrates most typically the clinical course of this form:

L. M——, female, nineteen years, had always lived in most affluent circumstances; had never been sick except from slight anæmia for the past two years. Father when a boy would bleed severely from slight causes. No further hæmophilic history.

March 7th, 1 A. M., slight chill without rise in temperature. Very nervous and anxious. 12.45 P. M., marked chill, fever rising to 103.5°, and epistaxis becoming more and more profuse in spite of every effort to check it.

March 8th, 1 P. M., first seen by author. T. 98.4°; P. 130, irregular and weak; marked pallor of skin; prostration profound; complete mental apathy, though her mind was clear when she was aroused. New purpuric spots appearing. Gums normal. No evidence of endocarditis nor of any other appreciable disease. Spleen enlarged; epistaxis still continuing, the blood being dark and not coagulating. Profuse uterine hæmorrhage. Hæmorrhages were checked by plugging posterior and anterior nares with cotton dipped in collodion and by firm tamponing. 8 P. M., T. 102.8°; P. 130–180, weak and irregular; semi-coma, alternating with periods of restlessness and mild delirium. Still slight hæmorrhages from nose and uterus in spite of former treatment. 10 P. M., about a pint of warm sterilized saline solution was given by rectum and by hypodermatic injections, with slight but temporary improvement. Cardiac tonics, whiskey, and digitalis were freely administered.

March 9th, 9 A. M., T. 104.8°; P. 148; R. 32. Large offensive tarry stool of altered blood. Injection of saline solution continued. 6 P. M., complete coma. T. 106.2°; pulse weaker and flickering.

March 10th, 2 A. M., she died, two and a half days after the onset of the disease. No autopsy was permitted, and bacterial examinations could not then be made.

Etiology.—There is no known cause for this disease. It occurs more frequently in men than in women. The average age of the males affected is twenty-eight years; of the females, twelve years. It has been observed, however, between one and seventy years of age.

The average duration of the attack is about one week, although it may last from one to twenty days.

Prognosis.—The prognosis is bad, 75 per cent. of the cases terminating fatally.

Treatment consists in—(1) checking the hæmorrhages by plugging the nares, by firm tamponage, or by the use of hæmostatics, as described in the subacute form. (2) In controlling the sepsis. This is often more than we can do, although in some cases alcohol in large doses seems to do good. (3) In the treatment of dangerous symptoms. Heart-failure is to be treated by hot applications over the precordium and by cardiac stimulants. The restlessness and anxiety are best controlled by opium given in small doses. Profound anæmia

is to be treated by external warmth, rectal and hypodermatic injections of a warm sterilized saline solution, elevation of foot of the bed, and ligatures applied to the extremities. Arterial transfusion is contraindicated.

2. Cases with Visceral Hæmorrhage.—In these cases the brain and the suprarenal capsules are the organs most frequently involved.

In the brain cases the disease begins with the ordinary symptoms of acute purpura hæmorrhagica. After several days these are followed by those of meningeal or cerebral hæmorrhage, usually multiple, and without any especial seat of selection. It is seen far more frequently in males than in females.

Illustrative Cases:

1. Girl, aged two years. For two days diarrhœa and vomiting; then purpura, fever, and collapse. Death in a few hours from multiple hæmorrhages into the medulla. (Züelchauer, *Berl. klin. Wochensch.*, 1869, No. 17.)

2. Young man. General acute symptoms. Death on fourth day from hæmorrhages into left Sylvian fossa, pons, and ventricles. (Kurkowski, *V. und H. Jahresbericht*, 1885, ii. p. 493.)

In cases of hæmorrhage into the adrenals the course of the disease is exceedingly acute, and death results in a few hours after the onset.

Illustrative Cases:

1. Soldier, aged twenty-two. Purpura; hæmorrhage from mouth, lungs, and kidneys. Death in seven hours from adrenal hæmorrhage. (Bourrieff, *V. und H. Jahresber.*, 1878, ii. p. 275.)

2. Male, aged two years and nine months. Purpura, fever, and collapse. Death in fifteen hours from adrenal hæmorrhage. (Wolff, *Berl. klin. Wochensch.*, 1879, No. 18.)

3. Cases Complicating Pregnancy.—In the cases in which the disease attacks pregnant women we have the ordinary acute symptoms at first, followed by miscarriage and post-partum hæmorrhage. It may also follow labor at term. The disease runs a rapid course, and recovery is rare.

Illustrative Cases:

1. Female, aged twenty-one, six months pregnant. Purpura four days; then rapid onset of increasing purpura, with hæmorrhages from nose, gums, kidneys, and stomach. Miscarriage sixth day, with post-partum hæmorrhage. Death on eighth day, four days after the acute onset. (Puech, *Annales de Gynécologie*, xvi., 1887, p. 273.)

2. Female, aged thirty. Five previous normal labors. Seven months pregnant. Purpura, with miscarriage in a few hours with post-partum hæmorrhage. Death on second day. (Phillips, *Brit. Med. Journal*, Nov. 13, 1886.)

3. Female, aged thirty-two. Seven previous normal labors. Seven months pregnant. Purpura, hæmorrhages from nose and mouth. Miscarriage on third day, with placental hæmorrhage. Recovery in two weeks. (Phillips, *loc. cit.*)

When we study these acute cases together, we are struck with their similarity to the class of acute infectious diseases. The absence of assignable cause, the rapidity of the onset, the multiplicity and scattering of the lesions, the enlargement of the liver and spleen, and the constitutional symptoms out of proportion to the lesions, seem to prove by analogy the assertion that we are dealing with an acute infection, the nature of which is at present unknown. Comparing these cases, however, with those of the subacute form, the identical symptoms are found in each, and it seems most probable that in both forms we are dealing with the same disease in all essential features, differing only in the intensity and rapidity of the infection. As the infection in the subacute cases seems to be due to the presence of Letzerich's bacillus, it is more than possible

that the acute cases may be due to a more intense infection by the same germ. Much attention has been called to the relationship of essential purpura hæmorrhagica to two diseases of the hæmorrhagic group—purpura simplex and purpura rheumatica.

Purpura simplex is due to a variety of causes. In some cases the cause is apparent, as in severe anæmia, debility, after certain drugs, or occurring in infectious diseases. In other cases no cause can be found and the nature of the disease is obscure. In either we may have mild or severe constitutional symptoms.

In purpura rheumatica we have not only simple purpura, but also pain and swelling of the joints. Formerly it was regarded as a separate disease from purpura simplex, but of late efforts have been made to associate them, purpura rheumatica being considered either as a purpura occurring in rheumatic subjects, thus accounting for the joint symptoms, or as a severe purpura simplex, in which hæmorrhages occur in and around the joints. The author regards the latter supposition as the more correct, as in all hæmorrhagic diseases, purpura hæmorrhagica, as well as scurvy, multiple sarcoma, etc., the joints may be affected, together with the appearance of purpuric spots. If this view be correct, why regard them as separate diseases? Is it not justifiable to consider purpura rheumatica as an intenser form of purpura simplex with hæmorrhagic joint lesions?

If purpura hæmorrhagica be due to an infection, may not the cases of purpura simplex occurring without known cause, and cases of purpura rheumatica not associated with rheumatism, be considered as lighter forms of the same infection, especially as in some cases of subacute purpura hæmorrhagica, purpura or purpura with joint symptoms may be the most marked features, the free hæmorrhages being of very slight importance, often not appearing for several days after the other symptoms? Even in the acute form is this seen, as the case of Puech's, cited on the preceding page, illustrates, the purpura alone existing four days before the onset of acute symptoms.

In support of this theory may be cited cases of secondary purpura hæmorrhagica, such as those occurring after the administration of certain drugs, in which small doses in some patients produce merely purpura, while large doses cause, in addition, free hæmorrhages and marked constitutional symptoms. The only difference seems to be that in one case we are dealing with a cause unknown, though probably bacterial, while in the other the cause is known, and by its intensity we have all grades, from simple purpura to purpura hæmorrhagica, even of an acute type.

II. Secondary Purpura Hæmorrhagica.

Under this class we include those cases of purpura and free hæmorrhages which complicate some existing disease or to which a definite cause can be assigned. In nearly all of these cases we may have either a simple purpura or purpura hæmorrhagica with constitutional symptoms of a mild or severe character, in some even running a fatal course. Only a brief mention can be made of these cases.

(1) *Cases due to the Administration of Certain Drugs*, potassium iodide, chloral, quinine, and salicylic acid being the ordinary drugs causing such a result. There is a great difference in their action in different patients, some developing no symptoms, others a simple purpura, while in still others we have a striking exhibition of spreading purpura, free and internal hæmorrhages, with coma, collapse, and even death. These various types can proceed from the

same cause acting more intensely upon some patients than upon others, either from a maximum of cause on the one hand or the minimum of personal resistance on the other.

(2) *Cases which Accompany or closely Follow Severe Infectious Diseases*, such as acute atrophy of the liver, snake-bites, typhoid fever, pneumonia, and the exanthemata ("black measles," etc.). In these cases we have various grades, from simple purpura up to acute purpura hæmorrhagica. Many authors attribute such a complication to an added infection of essential purpura hæmorrhagica complicating the primary disease. Henoch, for example, reports a case of a child with lobar pneumonia in whom a supposed infection of purpura hæmorrhagica occurred two days after crisis, causing death from collapse in twenty-four hours. If a drug like potassium iodide will so disorganize the blood or render pervious the blood-vessels, why may not the poison of an infectious disease produce the same result without supposing an added infection of a new disease? It is no argument against this view that purpura hæmorrhagica may appear after the crisis, because we know that a temperature crisis does not mark the end of the disease, but only, as Fraenkel has recently demonstrated in pneumonia, the end of the fever-producing quality of the infecting germ.

(3) *Cases of Severe Jaundice* may be accompanied by purpura and hæmorrhages. These seem to be due to the disorganization of the blood from the cholæmia.

(4) *Cases of Profound Anæmia*, *Leukæmia*, or *Pseudo-leukæmia*, and of *Exhausted* and *Cachectic Conditions*.—In these we may have simple purpura, purpura hæmorrhagica, or continued hæmorrhage after operations or injuries. We do not know whether to attribute these hæmorrhages to blood-changes or to changes in the wall of the small arteries.

(5) *Cases of New-born Infants with Congenital Syphilitic Changes in the Arterial Walls*, producing purpura, bloody sweating, and free hæmorrhages, especially from the umbilicus.

(6) *Cases of New-born Infants without Syphilitic Parentage*.—This form, according to Partridge, occurs in about 1 per cent. of cases, with a mortality of 60 to 75 per cent. He attributes its causes to the change of functional activities and to the altered circulation, allowing a brief interruption of the nutrition of the vessel-walls sufficient for the transudation of their contents.

(7) *Cases complicating Malignant Endocarditis*, the purpura and hæmorrhages being probably due to embolism of the capillaries by vegetation-fragments, and their subsequent degeneration and rupture.

(8) *Cases of Multiple Sarcomata*, *with Purpura*, with free hæmorrhages, purpura, rheumatic pains, and fever. It is hard to say whether these result from malignant cachexia, with blood-changes, or from emboli of sarcomatous fragments lodging in the small blood-vessels, causing their degeneration and rupture.

(9) *Cases occurring after Fright*, *Deep Emotion*, *Hysteria*, *and Hypnotism*. In these cases the hæmorrhages seem to be due to vaso-motor relaxation or to enfeeblement of the arterial walls sufficient to allow of the escape of their contents. This latter explanation is warmly endorsed by Weir Mitchell.

SCORBUTUS.

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Infantile Scurvy is a constitutional disease characterized by marked anæmia, spongy gums, excessive tenderness, swelling and inability of the lower limbs; it is also characterized by a rapid recovery after corrected regimen.

Etiology.—The most frequent direct cause is prolonged feeding upon patent prepared foods and canned condensed milk; or, to state this point more directly, *persistent deprivation of fresh food.* It most frequently occurs in the first eighteen months of life.

England is the source of most of the reported cases and of most of the literature of scurvy in children. To W. B. Cheadle and Thomas Barlow of Great Ormond Street Hospital is due the credit (the former) of "having first shown on clinical grounds the true affinities of this form of infantile cachexia," and (the latter) the anatomical nature of the disease determined by post-mortem examination. Professor Heubner of Leipzig has collected recently-published cases outside of England, estimating the entire number at about 50. Of these, Heubner has observed 4 cases; Rehn, of Frankfort, 7; Pott, 2 probable cases; and Northrup, 11 cases from American practice. At the present time 4 more have been added to the American list.

The reader will find in this book, for the first time, scurvy put down as a disease occurring in the United States. The explanation is, that this cachexia has been ascribed to rickets, and has found its way into literature as "acute rickets," or gone astray under purpura hæmorrhagica. Rickets predisposes to scurvy, but the two diseases are not regularly associated. They occur in children of the same age, and are induced by causes somewhat similar. Of the 15 cases collected by us, rickets was noted in 3, not mentioned in 4, and recorded as absent in 8. Rickets is a disease of general malnutrition, but no rickety child or other will become scorbutic unless its blood lack that certain something which is supplied by fresh food and fruits. Scurvy develops in wealthy and squalid environment alike. Two of our cases were in princely surroundings and tended with devoted care. One was a foundling. The first case in the writer's seven was fed upon one of the proprietary foods from the fourth to the sixteenth month of its life. The child thrived for a time, but was rather "backward" in development. On the other hand, it seemed satisfied with its food and never gave any evidence of rickets.

Another case, aged twelve months, was said by its mother to have been failing for two months. The child had been put out to board during this time, and its food had consisted entirely of condensed milk.

Dr. Delafield has furnished an interesting and unusual case of a child three

years old brought to him with obstinate diarrhœa. He prescribed a diet of scraped meat, and sent the child to the country for three months. In September the child was brought again to him with this history: it had recovered so satisfactorily from its diarrhœa, had seemed to thrive so well on the meat, that it was thought best, in order to perpetuate this happy state, to adhere conscientiously to the same regimen. As a result, the child on its second visit to Dr. Delafield presented typical signs of scurvy. On a rational diet the child speedily recovered. Three of our cases were fed *exclusively on proprietary food for months;* another upon a mixture of proprietary food and condensed milk. There is no evidence that sterilized milk has caused scurvy, nor any reason to believe that Pasteurizing milk predisposes thereto.

FIG. 1.



Specimen from a case of Infantile Scurvy, showing subperiosteal hæmorrhage about femur and tibia of the side less affected. (Drawn from the specimen preserved in the Museum of the College of Physicians and Surgeons, N. Y.)

The reactionary tendency against the routine use of patent baby-foods is justified. There seems no greater surviving fallacy current in medical practice than routine feeding of tender infants upon the patent products of commercial firms.

Pathological Anatomy.—The anatomical changes are chiefly due to hæmorrhage, the most striking and characteristic being the subperiosteal hæmorrhage of the femora.

A typical case of scorbutus in a child eighteen months old, an inmate of the New York Foundling Asylum, came under the writer's observation.

The autopsy gave the following results: The child was emaciated, its eyelids swollen and ecchymotic. The gums were prominent, spongy, dark, covered with dried blood, the lips blood-stained. The pale, thin face, with two "black eyes," gave a most striking appearance to the dead baby.

The main interest lies in the condition of the legs. As regards the organs, it is sufficient to say there were no hæmorrhages, but extensive pleuro-pneumonia of the left side. Left thigh symmetrically enlarged, larger than the right, though both were obviously above normal in size. Left femur was normal at its upper extremity, epiphysis and end of shaft. The lower half was invested with a black, grumous subperiosteal layer of blood having a thickness of two or three millimetres. The lower epiphysis was detached; the lower end of the shaft macerated, eroded, and soft, lying loose in the black, disintegrating blood-clot. The femur of the right leg was surrounded for its lower two-thirds by a thinner, black, subperiosteal blood-layer. The lower epiphysis was not detached, though both it and the shaft were congested. No hæmorrhage into any joints. The right and left tibiæ were surrounded by a thin, dark hæmorrhagic layer beneath the periosteum, and the proximal portions of both were congested. The fibulæ, likewise the bones of the upper extremities, were normal.

Microscopical examination of the bone disclosed no syphilitic or rachitic changes, and no inflammatory changes in bone or periosteum. The softened macerated bone gave no evidence of suppuration; but there was moderate congestion of the fellow femur and of the upper extremities of the tibiæ.

A small amount of blood, dark and disintegrated, was found in the intestines; no lesion discovered.

The accompanying illustration (Fig. 1) is drawn from a specimen which consists of a lateral half of the lower limb of the side less affected.

The above case corresponds very well to published English cases, and may be assumed to fairly represent the lesions of a well-marked typical case. It is worthy of note that the bone of the shaft was smooth, showing no signs of inflammation, and that the separation of the epiphysis was apparently due to the fracture of the softened bone above the normal line of junction of shaft and epiphysis. But few autopsies are on record, and now that the disease has been classified and its treatment understood, deaths and autopsies will be very rare indeed.

Symptoms.—The patients are usually anæmic, flabby, wasted, having the symptoms of marasmus; irritable, fretful, showing a disinclination to being moved or handled. They may or may not have signs of rickets. The symptoms thus far enumerated point to disturbed nutrition, and are not characteristic. After four to six weeks the child manifests pain on handling, excessive tenderness, especially on moving the limbs. At this time fusiform or cylindrical swelling of one thigh is noted, the limb being first flexed, later lying helpless and straight. This condition has been frequently diagnosticated as rheumatism, and treated for such. If we recall the lesion, the position and helplessness of the member are easily explained. The fusiform swelling and flexure are the result of the subperiosteal hæmorrhage about the shaft of the femur; the straighter and helpless condition of limb follows upon the further hæmorrhage and separation of the epiphysis. Finally, swelling and bleeding gums (if teeth are present), ecchymoses about the eyes, purpuric spots, hæmaturia, and intestinal hæmorrhage complete the picture.

The temperature may continue normal, or may rise as high as 101° or 102° F., with or without albuminuria.

The following are illustrative cases:

Case I.—Typical scurvy occurring in rich surroundings. The child had been treated for rheumatism without success. At the time of the consultation the father and mother of the little patient were present; both were within the thirties, healthy and vigorous, the father looking like a hardy yachtsman. The family history on both sides was good. The family were luxuriantly housed in the most hygienic surroundings of up-town New York.

The child at this time was sixteen months old, was the second born, a female, thriving very well in the early months of life; at the fourth month the mother's milk failed to be of sufficient quantity, and quickly thereafter ceased altogether. The first-born is still living and robust; the mother's milk had after a few months been insufficient for it, but the child continued to thrive. After the failure of the mother's milk in our patient's case one of the proprietary foods was given her. By some misunderstanding this food was diluted with water and milk, the proportion of the latter being too small. For a time the child thrived very well apparently, though it was rather backward. Its digestion was good, its bowels reasonably satisfactory, and it seemed satisfied with its food. It never gave any evidence of rickets; teeth in normal number made their appearance at the usual time.

Three weeks before the visit spoken of (this fact was subsequently elicited

after close questioning) the nurse had noticed some *change in the child's gums*. The change was not marked.

One week later than this the patient developed *trouble in the right lower limb*, evidenced by worrying, sensitiveness on handling, and a tendency to keep the limb nearly straight. There seemed no reason why the case should not speedily come out of its condition of slight depression, as the food was improved and antirheumatic treatment instituted.

During the succeeding week very little is known concerning the child: the parents were absent from home; the family physician was not called; the nurse drew no conclusions from the now rapidly changing gums, and as to the rheumatism the progress was slow.

The child cried on seeing a strange face, becoming alarmed also for the safety of its lame leg. In the wry face of crying the little patient fairly unbuttoned from between its lips two rows of irregularly nodulated, purplish gums, from the summits of which the points of its teeth barely protruded. *In the upper spongy row was a depression with ulcerated walls and sloughing shreds. The gums were dark, and bled freely* in the act of crying from compression of the lips alone. There was nothing further abnormal about the face beyond a worried expression; no ecchymoses, no petechiæ; conjunctivæ were normal; no evidence of unhealthy condition of the mucous membrane of the nose. There was no history of nose-bleeding, no hæmaturia, no hæmorrhages from the bowels. The child was now stripped of all clothing and laid upon its back on the bed. It continued to whimper, throw its arms about freely, draw up its left leg; as for its right, it could move it slowly, but only a little, and could not be induced to flex it. The *right thigh was somewhat larger than the left*, to observation; by measurement it showed a difference of about two and a half inches, which, considering the thin thighs of the small patient, augured a marked difference. The enlargement was fusiform, greatest just above the knee. Apart from the *spongy gums and swollen thigh* there were no external manifestations.

This case promptly recovered on corrected regimen, and will be mentioned again under Treatment.

Case II.—Fatal scurvy in a child of eighteen months; Autopsy. This child was an inmate of the New York Foundling Hospital, and was what is called a "nurse-baby;" that is, she was nursed by a mother who, in addition to her own baby, nursed a second of about equal age. Her own child thrived; the second furnished the example of malnutrition and the pathological specimen already referred to. Since we are considering a case of scurvy developing in a breast-fed (*sic*) child, it is well to bear in mind the above facts, and the added fact that nearly all babies nursing two at one woman require more or less artificial food. We are justified in forming our own conclusions as to which was nursed more and which less; we know which baby was hers and which was not, which thrived and which developed fatal scurvy.

Briefly, the history of the illness was as follows: The foster child when sixteen months old was observed to be failing, and, as the history reads, "on account of impaired nutrition was taken from the breast and was given vegetable acids." In the seventeenth month of life, which was one month before death, the right leg and knee became swollen and tender. Temperature was 101° F. After two days the symptoms seemed temporarily to disappear. Two weeks before death, and six weeks after the weaning, the child appeared to be very sick; her gums were swollen, smoky-black, and bled freely; two days later her left eyelid became swollen, black, having the appearance of the classical "black eye." Temperature thus far continued about 101° F. One

week later there developed the physical and rational signs of pneumonia. At this time her other eyelid became ecchymotic and the other thigh markedly swollen.

During the remaining days of life the little patient became excessively anæmic, having a metallic pallor, which gave a particular wretched appearance with the contrasting ecchymoses about the eyes. Her passages were black and pasty; no petechiæ; the child failed rapidly and died with pronounced symptoms of pneumonia. (For autopsy see "Pathological Anatomy.")

Case III.—(Dr. Chas. H. Richardson of the North Eastern Dispensary.) Annie K——, aged twelve months, was brought to the dispensary by her mother with the history of "failing" for nearly two months. The child was healthy for some time after birth, when the mother was obliged to work, and of necessity the baby was "farmed out." She reported the food as having been condensed milk.

The child had recently vomited blood, passed blood from the bowels, and presented small spots of subcutaneous hæmorrhage. The gums were slightly softened, and, according to the mother's account, the inside of the mouth had been black. Both legs were enlarged to considerably more than double their normal size. Epiphyseal ends showed marked enlargement. Limbs very tender, hard, and pitted slightly on pressure. "Head sweats. Temp., $100\frac{4}{5}°$."

The following paragraph gives the case an added interest and accuracy: "The swelling of the limb being due to subperiosteal hæmorrhage, added to subcutaneous œdema, I wished to see the character of the effusion next the bone. I thereupon passed an aspirating needle down to the femur and drew off some of the effused fluid. It consisted apparently of pure blood which microscopically showed the red globules somewhat ragged and disintegrated, and the white ones somewhat increased in number."

At this point the case escaped from observation and the history ends.

Case IV.—Dr. W. F. Lockwood of Baltimore furnishes the following:

"Aug. 12th, Mrs. W.——, whose family had been in the country during the warm weather, asked me to visit her child, thirteen month old, ailing for some weeks with diarrhœa varying in severity, but never entirely relieved. Of late she had thought the child suffered pain in the lower limbs, that it screamed in an unusual way at night, especially when moved or touched, and that there was increased fretfulness during the day. She referred also to some spots 'like old bruises' on its legs below the knees, more marked on the right.

"It had been nursed until six months old, after which time it had taken almost exclusively a proprietary food.

"Examination showed the child fairly well nourished, rather anæmic, complexion sallow. No evidence of rickets, no swelling along shaft or enlargement at ends of bones. Ill-defined ecchymotic spot on left leg, but plainer on the right. The right leg semiflexed and everted. No tenderness manifested on gentle manipulation of body or limbs. Gums showed dusky purplish fold at root of each tooth. They had bled occasionally for some weeks, and the stool had pretty constantly been streaked with blood. Pulse and temperature were normal.

The diagnosis of scorbutus was made and directions were given to change the diet to fresh milk undiluted, potato, and orange or peach juice. A few days after my visit the mother reported the child improved in every way. The diarrhœa had stopped, and there were no screaming or restlessness at night. A second visit was not required, and the improvement, I have heard, has continued."

Case V.—Dr. G. H. Whitcomb, of Greenwich, N. Y., has published a most illustrative case (*Archives of Pediatrics*, Oct., 1891, p. 760). The child, a girl, was eleven months old; after fifth month was fed exclusively on artificial food during which time she grew very fat, "seemed to thrive famously." "When a little over ten months old she became petulant, and evinced a disinclination to move or be handled. The legs were partially flexed and remained rigid. Any attempt to straighten them elicited screams. The gums were spongy and bled frequently; muscular pains were so severe as to deprive the child of rest." "The physician at that time in charge diagnosticated and treated rheumatism . . . . . After ten days the family went to Rome, ... where the diagnosis of rheumatism was approved and alkaline treatment pursued for two weeks after which they came to Greenwich."

In Dr. Whitcomb's graphic account occur such expressions as the following: "screams when handled; . . . . limbs resembled Bologna sausages; . . . . gums were spongy, ecchymotic blebs discharging sero-sanguinolent fluid; . . . . seven teeth; . . . . *no evidence of rachitis.*" Treatment compressed fresh milk, rare-broiled beefsteak, and sweet oranges.

In three weeks the child was restored to complete health. The doctor believes the scorbutus to have been caused by the exclusive use of prepared food, and he concludes that "no cereal or chemically prepared food can nourish perfectly," but should be supplemented with fresh milk, meat, and fruit juices.

Diagnosis.—In a well-marked case the recognition of scurvy is not difficult. Exquisite sensitiveness of lower limbs, one or both; swelling of the thighs, fusiform or cylindrical, firm (sometimes œdematous), non-fluctuating, without marked local heat; stiffness, inability; pseudo-paralysis of the limb; deep thickening of the femur (late); crepitus at lower end (late).

Of the gums the characteristics are swelling, sponginess, bleeding on slight pressure, dusky purplish color, "smoky."

Not least important is the prompt improvement on corrected regimen.

Prognosis.—Recovery may be confidently expected even in well-advanced cases, provided the proper nursing can be obtained. Death is usually due to exhaustion. In cases not too far advanced the results of proper treatment are most satisfactory—little short of magical.

Treatment.—Correction of faulty regimen is usually sufficient to produce a marked change in a few days. So marked and so prompt, indeed, is improvement that it may be considered a satisfactory confirmation of diagnosis and a characteristic of the disease.

Briefly, *give fresh milk and orange-juice.*

Referring once more to the memorandum of Case I (under Symptoms), the child was removed at once to the country, its proprietary mixture was stopped, and in its place was given fresh cow's milk, expressed juice of beef, baked potatoes, etc. The one thing which this scurvy patient seemed to crave, for which she reached out, which she seized with ravenous avidity, was *orange.* The child could hardly be restrained till she held the fruit in her grasp, and then proceeded to souse her lips and nose in the juice. Improvement began at once; in five days the gums were markedly better, in ten entirely normal. As for the thigh, at the end of ten days the improvement in its condition was marked, and a month later the child was standing on her feet. A slight thickening over the femur could be detected for a few days longer, at the end of which time the patient seemed absolutely well.

General supporting treatment should be given in the exhausted condition of advanced cases: a few drops of brandy, well diluted and administered judiciously at one to four hour intervals; abundance of fresh air; cod-liver

oil; albuminate or peptonate of iron. The condition of the bowels may require attention.

The care of the limbs depends upon the extent of the lesion. A separation of epiphysis requires plaster splints. Usually, nothing need be done for the swelling or to assist absorption of the effused blood. For the swollen gums, if bleeding be troublesome, it may be necessary to apply some mild astringent, glycerite of tannin with a few drops of carbolic acid being recommended.

PART VI.

DISEASES OF THE DIGESTIVE ORGANS.

DISEASES OF THE MOUTH AND DENTITION.

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I. DISEASES OF THE MOUTH.

The mouth of an infant differs in many respects from that of an adult or even a child: up to the third or fourth month of life it is to be looked upon merely as a passage-way for food. Then comes the first outpouring of saliva, and with it the functions of the mouth are increased by that of incipient digestion, which reaches its full development after a period that varies in individual cases. The lack of saliva produces more or less dryness of the infant's mouth, a coating of the tongue due to epithelial cells, detritus, and food, and a peculiar glistening appearance by reflected light. After saliva is formed the child does not, at first, know what to do with it, so that, even when normal in quantity, the greater part of it is not swallowed.

For most of the inflammations of the mouth the etiology is still a matter of surmise. While there can be no doubt that lower forms of life must play a very important rôle in their production, yet as a matter of fact but few forms of stomatitis can be definitely ascribed to this cause. The mouth is a veritable culture-tube for microbes and lower forms of life, but, as a rule, they do not produce disease. General conditions of the patient must seriously be taken into consideration (syphilis, rickets, scurvy); possibly these may produce a soil favorable to low conditions of life, resulting in the production of troubles in the mouth. Local conditions within the mouth must always be sought in examining a case—lack of cleanliness, rough attempts at cleansing, sharp or diseased teeth, the introduction of irritants or poisons; while, on the other hand, causes may be found only in diseased conditions of remote organs. One important fact must always be taken into consideration, that the glands of the mouth are not only secretory, but also excretory, so that substances taken into the circulation, as well as others formed within the body, may leave the body by means of these glands and produce local lesions.

In the matter of treatment care must always be exercised in removing the cause of the disease; where this is impossible, purely symptomatic treatment is called for, and this, in the main, is antiseptic in nature. The most potent mouth-antiseptics are potassium chlorate, potassium permanganate, silver nitrate,

and sodium salicylate. Each one has its own indications, but the first and second are almost universally serviceable. Potassium chlorate, especially, when used internally, requires cautious administration on account of its effects upon the blood and the kidneys. It is safe to say, however, that the danger has been largely over-estimated by some, and in comparison with the frequency with which the drug is used the number of cases of poisoning is exceedingly small.

The examination of the mouth should be thoroughly conducted, without force, but in such a way that all parts can be seen to advantage. It is necessary to insist upon this part of clinical examination, since, simple though it be, it is frequently neglected, so that very valuable aids to diagnosis in many diseases are overlooked.

The classification which follows is one which is principally based upon clinical data; it is completely satisfactory as a working formula up to the present, but will undoubtedly require revision in the future. The term "stomatitis" is retained for many reasons, not the least important being that it has been used quite universally. The following are the forms of stomatitis: I. Stomatitis catarrhalis; II. Stomatitis aphthosa; III. Stomatitis mycosa; IV. Stomatitis ulcerosa; V. Stomatitis gangrenosa; VI. Stomatitis crouposa; Stomatitis diphtheritica; VII. Stomatitis syphilitica.

I. Stomatitis Catarrhalis.

Also called simple stomatitis, of which there are two kinds—local and general.

Etiology.—Two things must be taken into consideration—an irritant and the mucous membrane. In healthy children the mucous membrane resists to a greater extent than in children sick with any disease whatsoever. The most favorable conditions for the production of stomatitis catarrhalis are to be found in children with acute febrile disease and in bottle-fed babies. The irritants are either mechanical, thermal, chemical, or to be traced to some lower form of life acting mechanically or chemically. In healthy children teething does not produce stomatitis, and it is denied by many that this process is even a predisposing cause. Lack of cleanliness, over-cleanliness, and food introduced at too high a temperature are common causes for this trouble. Many of the acute infectious diseases produce stomatitis catarrhalis, which then precedes the appearance of the characteristic lesions within the mouth. Nearly all other forms of stomatitis are preceded by this form—most especially is this the case with stomatitis mycosa; and all other forms are associated with more or less catarrhal inflammation. In all probability, substances excreted by the glands of the mouth, as the result of faulty digestive processes in the intestines or of incomplete elimination, will be found to be of vast importance in the etiology. This will be the most rational way of explaining the frequent concurrent appearance of diseased processes within the mouth and the intestinal tract. For the localized form, it is a local irritation—a sharp tooth, a discharging abscess, or the rubbing of the gums to facilitate teething.

Symptoms.—We may recognize two varieties, the erythematous and the true catarrhal. In the erythematous form the whole mucous membrane of the mouth is of a deep-red color, produced by hyperæmia. The blood-vessels are sometimes subjected to such great pressure that rhexis occurs, or red corpuscles may be forced into the submucous tissues, and the hæmoglobin may there be changed to hæmatoidin, with a resulting distinct yellow discoloration. This condition is frequently found in the mouth of the new-born; erythema

of the mouth may be looked upon as normal during this period of life, requiring no treatment except gentleness, and is of no special importance.

In pertussis and the acute exanthemata there is produced a peculiar form of erythematous change. In pertussis and measles it consists of a blue tint given to the tongue and the buccal cavity; in scarlatina the whole mouth is more or less reddened, and in all the acute exanthemata the eruption appears in well-defined places in the characteristic form seen upon the skin.

In general stomatitis catarrhalis we have all the symptoms of an inflammation—swelling, pain, heat, redness. The whole lining of the mouth is hyperæmic; there is more or less puffiness, especially where there is pressure, and here the mucous membrane is somewhat paler. The lips frequently become more tense, and the mucous membrane is covered with small, round prominences due to swelling of the muciparous follicles. When the ducts of the latter become tightly closed the glands dilate, and there are produced cysts, the contents of which are clear, viscid mucus. We also find slight epithelial abrasions, sometimes leading to the production of a deeper process—at all events, important in that they may become the seat of infection.

The tongue is coated, at first dry and white, then yellowish or grayish, and, as secretion increases, whole flakes of this coating are washed off, leaving red spaces partially uncovered. The tongue never looks like the scarlet-fever tongue, since the catarrhal process seems to affect only the superficial layer of epithelium, sparing the fungiform and even the bases of the filiform papillæ. When this process in the mouth is the result of long-continued fevers, the appearance changes; nutrition to all epidermal structures being less active, the tongue and the mouth suffer comparatively more than when the process is purely catarrhal.

In nearly all the inflammations of the mouth the lymphatics become involved, and the intensity of the stomatitis can be measured, as a rule, by the degree of involvement of the glands. Increased temperature is observed (in rare instances as high as 104° F. in the rectum), the prominent symptoms, however, being local. Of these the most important is pain, producing restlessness, fretfulness, and more or less difficulty in nursing. With this, when the child is old enough, there is increased flow of saliva, producing, sometimes, irritation of the skin upon the lower lip or eczema of the face.

Prognosis.—As this is usually an acute process of moderate intensity, the prognosis is good. Indirectly, there may be produced loss in weight, dyspepsia, catarrhal conditions of the intestine, continued enlargement of the glands, possibly tuberculosis, and, therefore, a vulnerability of the mucous membrane, so that the smallest local irritant will be followed by a return of the stomatitis.

Treatment.—In the majority of instances the disease runs its course without any special treatment. The cause must be removed when possible. Next, relief must be given to symptoms; cold water, applied by means of cotton, either wrapped around a stick or the finger of the nurse, or small pieces of ice wrapped in a handkerchief. All food must be given cold; usually this causes least pain; sometimes the opposite will be found necessary. Much comfort will be given by frequent and gentle washing of the mouth with ice-cold sterilized water, to which there has been added boric acid (1–3 per cent.), sodium biborate (2–3 per cent.), zinc sulphate ($\frac{1}{2}$–1 per cent.), sodium salicylate (1 per cent.), etc. The addition of any of these is not imperative; chlorate of potassium is unnecessary and without value in this form of stomatitis. Silver nitrate ($\frac{1}{2}$–1 per cent.) is the most reliable of all remedies; if the stomatitis does not disappear in four or five days, the mouth must first be

thoroughly cleaned, and then pencilled with this weak solution once a day. Where there is loss of epithelium the spot should be touched with the mitigated stick, which can be accurately applied by first melting and then dipping a silver probe into it. Cysts should be duly opened, and their walls should be cauterized when necessary.

II. Stomatitis Aphthosa.

Aphtha (from *αφθα*, an eruption or ulceration) is a subepithelial vesicle of different color from the mucous membrane upon which it occurs, and is surrounded by an areola which changes in a peculiar way during its existence. It has nothing to do with the muciparous follicles, appearing in places where there are none; it is therefore not follicular.

Etiology.—No uniform local cause has ever been found. Micro-organisms, usually pus-producers, have been observed, but no connection could be discovered between them and the disease. Aphthæ have been produced artificially (caustics, the end of a burning match), but no one has ever succeeded in producing the whole series of symptoms associated with this form of stomatitis. It is said that the disease is most common between the tenth and thirteenth months of life (Bohn), and therefore teething has something to do with the eruption. However this may be, we find stomatitis aphthosa associated with a great number of diseases—pneumonia, ague, gastro-intestinal catarrhs, the acute exanthemata, etc. We must therefore look for the cause in a general, not a local, disturbance, and as the disturbance is the same as herpes, the same etiology will be found to hold good for aphthæ as for herpes. The disease is not contagious, but the same cause may not infrequently produce it in several members of the same family, and usually those are selected whose digestive tracts are either temporarily or permanently weak.

The foot-and-mouth disease in cattle can be definitely accepted as causative, but as this disease is very rare in this country, it can be almost absolutely excluded as an etiological factor. In a recent epidemic near Berlin studied by Siegel, an ovoid bacillus 0.5μ long was found in all cases; only those connected with the animals had local lesions, but were protected in a measure, infection taking place from man to man.

The conclusions arrived at by the author in regard to the etiology of this disease are as follows: It is a disease produced by some form of deleterious material in the circulation, which may have its origin in various processes, bacterial or otherwise. It may, therefore, be of various kinds. This material acts upon a nerve or nerves, or upon a nerve centre or nerve-centres, and produces an herpetic eruption which is the aphthous process.

Symptoms.—On the part of the general system there is a great diversity, depending largely upon the patient affected. We may have, for two or three days preceding the eruption, manifestations pointing to the inception of almost any disease common to children—vomiting, constipation, high fever, pain in the throat or mouth, enlargement of lymphatics, a slight cough, depending upon the localization of the disease, and even nervous symptoms, so that it will be almost impossible to foretell what is coming. On the other hand, some patients are very little affected beyond a slight rise of temperature, fretfulness, and loss of appetite. An examination of the mouth made at this period usually reveals stomatitis catarrhalis, sometimes a whitish spot upon the tonsil. Then, possibly the next day, the characteristic eruption appears with lightning rapidity. This consists of white or yellowish-white subepithelial spots, single or in groups, surrounded by an areola, and developing anywhere within the mouth, not uni-

lateral, and sometimes extending into the pharynx, and possibly also into the larynx. After from twelve to thirty-six hours the epithelial coating is soaked off, and there is left the so-called aphthous ulcer. After a few days more the floor of the ulcer is clean or the exudate is lifted up between regenerating epithelial cells; it is lifted beyond the level of the mucous membrane, and finally disappears. Some aphthæ are absorbed without going through this normal course. They appear in successive crops, and it is not unusual to have the course of the disease extend to from ten to fourteen days. The exudate is made up of fibres, indifferent cells, and various lower forms of life. No cicatrix is left where these spots have been, showing that the submucous tissue has not been affected.

The local symptoms are those of stomatitis catarrhalis; where denudation takes place there is more pain. The most common complication which occurs is stomatitis ulcerosa, and unless this is present the saliva in stomatitis aphthosa is never fetid—a matter of great diagnostic importance. In some instances the aphthæ are so numerous that the mouth looks as if it were covered by a diphtheritic membrane. A day of waiting will clear away any doubts on the subject, as by this time the characteristic denudation will have appeared.

Prognosis.—The prognosis is absolutely good. The disease is self-limited, doing no harm except to interrupt the general thriving of the child. Infection with other poisons has been known to take place, but this, fortunately, is very rare. Relapses are very rare, and the small ulcers, as a rule, heal without difficulty.

Treatment.—This is the same as that used for catarrhal ulcers—viz. the nitrate of silver. Permanganate of potassium may be used locally to great advantage (gr. iij to f℥j), but must not be looked upon as a specific. General treatment, as a rule, is not required, and when it is necessary it is purely symptomatic. Laxatives, usually given early, seem to have no influence upon the process; calomel does not abort it, and must be used according to the indications which govern its administration in other conditions. The poison has done its work before we are able to attempt to counteract its bad effects; it is probably eliminated by the time we see the patient, and therefore all causal therapy is futile.

Bednar's Aphthæ are found only in the new-born. They are shallow ulcers covered by a gray or yellowish coating, and found upon the soft palate, the posterior part of the hard palate, the palatine suture, always near the velum palati. They may be mistaken for the ulcers produced by the breaking down of milia or retention-cysts, or for that condition described by Epstein in which there are congenital defects in the mucous membrane filled up with epithelial detritus.

These aphthæ are always produced by violence in cleansing the mouth; this explains their position and their course. They are rarely found in private practice except where the midwife still holds absolute sway. Their course is benign, they require no treatment, and are only dangerous when they become infected. With the modern rubber nipples, when badly shaped, they sometimes develop far forward upon the hard palate; changing the shape of the nipple always results in their cure.

III. Stomatitis Mycosa.

This condition, commonly termed Thrush, is a disease produced by a peculiar fungus, first discovered by Berg of Stockholm, and called oïdium albicans by Robin. Rees and Grawitz were the first to show that the fungus is not an

oïdium, but a saccharomyces. All later investigations agree in showing that it is not oïdium, but all do not agree that it is saccharomyces albicans. For the present, however, until the exact position of the fungus is determined, it seems wise to adhere to the last name, saccharomyces albicans.

Etiology.—The fungus is the only cause, but it must be deposited upon favorable soil to produce the disease. The saccharomyces albicans may be found upon every mucous membrane in the body, the alimentary, the respiratory, and genito-urinary: it has been found in the parenchyma of organs, as the brain and lungs, and in blood-vessels. It is usually carried to children by the nipple or by the nursing-bottle. The fact that weak and unhealthy children are most predisposed to thrush has been emphasized entirely too much: perfectly healthy children have thrush. It has also been stated that flat epithelium is necessary for the development of thrush; this, however, can no longer be maintained, as we see the fungus on a great many surfaces lined by cylindrical epithelium. It is admitted on all hands, however, that catarrhal stomatitis exists either before or with the appearance of thrush. It is more than probable that this is the predisposing cause, and that it works mechanically—viz. by a dislocation of the swollen cells, preventing perfect protection to the mucous membrane, and allowing the spores of the fungus to find a place for development. Anything producing this mechanical injury to the membrane of the mouth, such as badly-formed or hard nipples, will act in the same way. The younger the child or the weaker, the more successful will be the implantation of the saccharomyces, because the function of motion of the tongue and jaw will be least developed. The disease is therefore found especially in infants reduced by illness, and in older children in connection with diseases that are followed by great loss of strength, such as long-continued fevers, wasting diseases, or those in which motion is very much impaired.

The fungus is found in two forms, depending largely upon the culture-material—the yeast form and the globulo-filamentous form (frequently called mycelium). There is no ascospore; therefore, according to Roux and Linoissier, the fungus is not a saccharomyces. The chlamydospore has, however, not been satisfactorily worked out. Propagation goes on in three ways—by filaments produced from conidia, by isolated conidia, and by spores.

Pathology.—The first lodgement comes between the epithelial cells of the mouth, and from this the growth works its way toward the free surface and toward the mucous membrane proper. In the direction of the free surface the growth is not so luxuriant, but in both directions it is principally in the mycelium form. In mucous membranes lined by flat or squamous epithelium the growth of the saccharomyces is facilitated by the relation of the cells to each other; in membranes lined by cylindrical epithelium growth takes place, but not so readily, because there is but one layer of cells. After the first development growth goes on very rapidly: after having found a nidus, the cells are pushed aside, surrounded by mycelium, the whole forming the characteristic thrush-spot. Pus is rarely produced; when this does occur the affection is of a complex nature. The growth begins in small spots, sometimes one, sometimes more; from these infection spreads, and at times the whole mucous membrane is covered with a rich growth of the saccharomyces.

Symptoms.—Preceded or accompanied by stomatitis catarrhalis, the local symptoms vary with the intensity of this process. Frequently no symptoms are present, and the existence of the small spots is the first indication of the presence of thrush. These vary in size, seem a part of the mucous membrane, are usually of a grayish-white, creamy color, and may or may not be elevated above the surface of the mucous membrane. They appear first upon

the tongue and cheeks, then frequently upon the lips and soft palate, and may be found upon the tonsils, the pharynx, or the œsophagus. With only moderate care of the mouth they seem to last indefinitely; without care they spread rapidly, and instead of the spots we may see membranes, in the case of the œsophagus whole casts being formed, which fill its lumen and often prevent swallowing. In hospital practice thrush has proved a formidable disease; in private practice it amounts to nothing more than a local disturbance, unless neglected. In the latter class of patients there is always associated some gastro-intestinal disturbance, which may prove serious if not fatal. In debilitated subjects—and thrush, from the mechanical reasons pointed out before, is more common in such—these gastro-intestinal troubles may be the affection which terminates the child's life. When the membrane drops off there is left a slight abrasion which may become the focus of infection by any other morbific agent.

But it must not be inferred that thrush occurs only in debilitated or sick children. It may occur in children that seem perfectly healthy, although careful investigation will always reveal some lesion in the mouth which has preceded the thrush. Again, not every child with stomatitis mycosa has gastro-intestinal symptoms: the food carrying saccharomyces frequently carries other lower forms of life capable of producing diarrhœa, but in properly-treated cases these symptoms are wanting, and when taken early enough thrush is local, and local only.

The thrush-spots develop within the epithelium, and examination by reflected light will show this: the spot is often surrounded by a narrow ring of injected blood-vessels. Removal from the mucous membrane requires considerable violence. The next step in development is a pushing up beyond the level of the mucous membrane, and after this more extensive infection of the mouth may be expected unless counteracted by treatment. At times the whole mass may drop off and leave an ulcer, sometimes very intractable, or the many spots may coalesce to form a membrane. The differential diagnosis is not difficult if all the above be taken into consideration, and a positive diagnosis can be made under all circumstances with the microscope.

Treatment.—Prophylaxis is very important. In young children all abrasions and all slight forms of stomatitis ought to be looked after. Everything coming in contact with the mouth of the infant should be kept aseptic—the nipples, the feeding-bottle, the food.

The treatment is simple enough if properly carried out. A solution of sodium bicarbonate (1 drachm to a tumbler of water) is to be applied with a brush between the times of nursing or feeding and immediately after feeding or nursing. Ulcers should be treated as has been described under Stomatitis Catarrhalis. Œsophageal thrush, when the diagnosis is possible, should be treated by the introduction of a soft-rubber tube (catheter) into the stomach. The intestinal troubles are best treated by small doses of calomel or corrosive sublimate, combined with careful diet.

IV. Stomatitis Ulcerosa.

This is a peculiar process, characterized by destruction of tissue, beginning on the gums around the teeth, never extending beyond the mouth, infecting healthy parts of the mouth, and never occurring where there are no teeth.

Etiology.—A clinical picture resembling the disease is produced by the internal administration of certain remedies—mercury, copper, and iodine. Mercurial stomatitis is almost identical with stomatitis ulcerosa, and in these

cases we find that a local irritation caused by bad teeth or uncleanliness of the mouth is a decided factor in the production of this affection. But, in addition, the remedies are excreted by the mouth, and in this fact there is to be found a possible clue as to the etiology of stomatitis ulcerosa. Whether, in addition, there are lower forms of life or chemical substances, or both, which cause this peculiar form of inflammation, it is for the present impossible to decide.

The disease usually develops in connection with bad hygienic surroundings, or following certain diseases, especially measles and scarlatina, and frequently malaria, pertussis, typhoid fever, or pneumonia. It is said to be endemic in the wards of certain hospitals or in certain barracks; and damp, poorly-ventilated houses, with or without insufficient nourishment, certainly favor its development. The disease is usually held to be non-contagious, but experiments with inoculation have proven to me that, with proper precautions, the disease can be propagated. It is not infrequent with soldiers, especially when confined in barracks, and the likelihood of a scorbutic affection being the predisposing factor cannot be disposed of at present. It is rarely observed before the age of five years, most frequently between the ages of five and ten, but it does occur at any time of life, provided teeth be present.

Pathology.—The process is one of necrobiosis. There is cellular death, but at the same time there results softening of the tissues, and not death *en masse*. The peculiarity of this form of necrosis is that it does not respect any form of tissue, but may extend to the periosteum, finally producing necrosis of bone. It is not unusual to find sequestra of large size ready to be removed. The process may, at the same time, produce caries of the bone, although this is certainly exceptional. The disease always begins at the free border of the gums, from which it extends in all directions, frequently infecting healthy mucous membrane, but never extending beyond that of the mouth.

Symptoms.—We first find swelling of the mucous membrane only at the lower part of each tooth (most commonly the lower incisors), and this gradually increases until the curved outline of the gum is converted into a more or less straight line. This swelling may become so great as to produce eversion of the part affected; at the same time there is great injection, almost lividity, accompanied by more or less bleeding upon the slightest provocation. The anterior aspect of the gum is first affected, but in severe cases the posterior portion also takes part in the process. Soon the gums can be detached from the teeth, and there is exposed a cavity or sac filled with a muco-purulent secretion. These characteristic local symptoms are further distinguished by the appearance upon the swollen gum of a yellowish seam, which may become a broad band. This represents the ulceration, and is due to cellular necrosis. With this there is a constant flow of fetid saliva from the mouth, but the odor comes from the diseased gums, except in very bad cases, when it may in part occur from diseased bone. In older children subjective symptoms are slight; in younger ones the principal evidence is pain, fretfulness, change in disposition, crying, and wakefulness.

The outpouring of large quantities of saliva commonly produces eczema of the lips, which may persist long after the cause has been removed. The lymphatic glands are always involved; they are soft, and remain enlarged frequently for a long time; as a rule, they do not suppurate, although this may occur some time after the disease in the mouth has run its course.

At this stage the disease is very amenable to treatment; if left to itself, it goes on indefinitely and develops. The yellowish seam increases, and when removed there is exposed an ulcerated surface. There is greater formation of

pus: the gums become more detached from the teeth, which are loosened. Ulcers may now form upon other parts of the mouth, the lips, the cheeks, the tongue. In very bad cases the whole of the mucous membrane covering the body of the lower gum has ulcerated away, and we look in upon a cavity filled with offensive pus, bleeding, and possibly showing a piece of denuded bone at the bottom. In these cases salivation has reached its maximum development, and the whole room may become tainted with a peculiar foul odor. Sometimes ulcers form upon the mucous membrane joining the lower lip to the gum; wherever they may be, however, it is always the characteristic sequence: first, necrobiosis, the seam surrounded by injected tissue, then ulceration below.

Nature rarely cures these cases without assistance: when cure takes place the symptoms disappear slowly, but in every case the disappearance of the fetid saliva is the first symptom of improvement. Sometimes the disease becomes chronic; it then runs an exceedingly mild course when deep tissues are not involved. It always takes some time for this to take place, so that if a patient has had stomatitis ulcerosa for several months without involvement of deep structures, it is more than probable that we are dealing with the chronic form. This is characterized by its resistance to ordinary methods of treatment and by the frequency of relapses.

Prognosis depends upon three factors: the disease upon which stomatitis ulcerosa is engrafted, the stage of the disease, and the treatment. The worst form is found in scorbutus. Where bone-changes are present the disease assumes the aspect of a disease of bone, but the prognosis is not bad when the condition is recognized. The important fact that stomatitis gangrenosa sometimes develops must never be forgotten: every case of stomatitis ulcerosa, therefore, requires most careful watching.

Treatment is prophylactic and curative. Improve the hygienic conditions of the patient and prevent extension of the disease to others. Chlorate of potassium can be looked upon as almost a specific in this affection. It is to be administered, with all precautions, in a 3 per cent. solution, of which ½ to 1 teaspoonful is given every two hours. At first its administration is accompanied by pain, sometimes very intense, but this no longer occurs in from thirty-six to forty-eight hours after treatment has begun. It takes about twenty-four hours for the remedy to produce any appreciable effect, and this is evidenced by a diminution of salivation. Soon this hypersecretion disappears entirely, and with it the fetid odor from the mouth; in the course of a week, usually, all symptoms will have disappeared. If ulceration has not disappeared at this time, careful search must be made for the cause. Carious teeth must either be removed, filled, or otherwise treated by antiseptics: if this does not remove the ulceration, recourse must be had to cauterization, either by nitrate of silver or the galvano-cautery. Dead bone must always be removed. Where the cause of a continuance of the process cannot be found, frequent applications of permanganate of potassium yield good results. As a last resort, the teeth around which the ulcerative process is best developed must be extracted and the cavity frequently washed, when the process will soon be found to come to an end. As potassium chlorate is a remedy almost specific in its properties, any other medicaments will hardly ever become necessary.

In chronic cases potassium chlorate does not act so universally; here, however, its use is also indicated, combined with local treatment in the form of applications of silver nitrate three times a week.

V. Stomatitis Gangrenosa.

This disease, termed also cancrum oris, gangrene of the mouth, or noma, is comparatively rare, most common in hospital practice, and in private practice depends for its frequency principally upon the surroundings. It is a gangrenous process, beginning upon the gums or inner surface of the cheek, spreading with great rapidity, and destroying every kind of tissue upon which it develops.

Etiology.—There can be no doubt that the disease may become infectious in its nature; several cases occurring in the same family or a number breaking out in one ward of a hospital can be offered in evidence. On the other hand, a great many cases are observed in which it seems to be impossible to take into consideration anything like contagiousness; a case occurring in a patient miles out in the country where no other case of noma has ever been observed in that neighborhood.

Noma occurs only in children sick with other diseases, never in healthy children. Furthermore, it follows in the wake of such diseases as produce great debility and least cellular resistance. The diseases most commonly followed by noma are—the acute exanthemata (especially measles and typhus), whooping-cough, syphilis, scorbutus, chronic intestinal catarrhs, and malaria. The excessive use of mercurials has been frequently considered the cause of this disease; no doubt such consequences have followed the heroic doses of former days, but are certainly exceptional now. Stomatitis ulcerosa is frequently a forerunner of noma, being the result of identical predisposing causes, but in all probability the resemblance of the two processes ceases there.

A great many lower forms of life have been found, but the testimony as to their causative relation is, as yet, inconclusive. Short rods, as in pulmonary gangrene, and streptococci (Cornil and Babes), streptococci resembling those found by Koch in progressive tissue-necrosis of white mice (Ranke), and bacilli in thread-like growth (Lingard), have been looked upon as the immediate cause; but the predisposing cause, after all, is the most important, and the probability is that sooner or later any number of different kinds of organisms, both pathogenic and otherwise, are developed in every case of noma.

Pathology.—We find all the evidences of a phlegmonous gangrene. Surrounding destroyed tissue there is an infiltrated zone. The latter is a true necrobiotic process, all evidences of cellular tissue being destroyed, only a homogeneous substance in which are found micrococci being left. Around this is found increased connective tissue, the connective-tissue corpuscles in active cell-division, while the blood-vessels are closed by thrombi and lower forms of life. Outside of this we find healthy tissue. In every case of noma these four zones can be distinguished.

Symptoms.—The first and most characteristic symptom noticed is the odor of gangrene. Upon examination an ulcer will be found upon the gums or the inner surface of the cheek; this spreads very rapidly. Very soon the whole cheek begins to swell; it becomes œdematous, the skin is waxy, and within twenty-four hours the whole side of the face may become involved. Sometimes the swelling is painful, but frequently children will not complain of any local symptoms. The ulcer in the mouth has now become deeper, and is evidently eating its way through the cheek, producing symptoms almost pathognomonic as it comes nearer the skin. The latter becomes discolored, red, blue, purple, black. Sometimes a bulla filled with ichorous fluid is formed upon the cheek; then the epithelial covering breaks down, and with it the gan-

grenous process goes on from without inward. Where no bulla is formed the gangrene goes on from the mucous membrane to the skin. Perforation of the

FIG. 1.



Cancrum oris in a child five years old.

cheek takes place under all circumstances and in a very short time—from twenty-four hours to three or four days. As a rule, the process continues, involving the whole of the cheek, the neck, the eyelids, destroying the eye, but rarely becoming bilateral. The bones are denuded, the teeth become loose, the tongue, hard and soft palate, even the tonsils, may become infected, and there is left a discolored, fetid, soft mass. The whole terminates in producing probably the most repulsive appearance the physician has opportunity to see. The odor is frightful, filling the whole house; the flow of saliva is very much increased, and death usually results from the depressed general condition. Spontaneous recovery is rare: a line of demarcation then forms around the gangrenous spot, the surface is covered by granulations, and finally cicatrization follows, leaving most horrible scars. Relapses sometimes occur, but they are rare. The whole duration of the disease is from one to three weeks, sometimes longer, depending upon the vitality of the patient. The general symptoms are usually those of the disease upon which noma is engrafted. Sometimes children with noma are found playing in bed, picking out loose teeth, and apparently little concerned about the intense fatal process going on upon their cheek. This is, however, not the rule, and when it does occur it is followed in a short time by general symptoms showing the severity of the local process. The temperature is sometimes very high, becoming hectic in type, but not infrequently it becomes subnormal before death. The pulse is small, easily compressed, weak, and rapid. The appetite is diminished, and diarrhœa is the rule, most intractable in its nature and probably due to infection from the process in the mouth. Catarrhal pneumonia, due to inhalation of septic material, is common, and diphtheria

has been observed in several cases. Exhaustion comes on, and then the child becomes apathetic, refuses food, and dies in collapse. Hæmorrhages are rare, because the blood-vessels are filled with thrombi.

Prognosis.—This is very bad, the mortality ranging from 70 to 90 per cent. of all cases affected. Complications make the prognosis absolutely fatal.

Treatment.—Of the general treatment, always of great importance, little new can be said, as the physician has already done all in his power to avert a gangrenous process by keeping up the strength of the patient. When noma sets in stimulants should be used methodically and systematically; food should be given in as condensed a form as possible. If feasible, rectal alimentation may be tried, but this, as a rule, is not very satisfactory for children.

The local treatment is of prime importance, and, as the mortality is so great, even the most heroic treatment can be adopted with complacency. The principle of local treatment is to destroy the infiltrated zone and the healthy tissue surrounding it for some distance, so as to make an artificial line of demarcation. Nitrate of silver in stick, dilute muriatic or other acids, chloride of zinc, and many other remedies have been recommended for this purpose. To the author it seems that the best and most active method of destroying this tissue is to be found in the use of the thermo-cautery of Paquelin or the galvano-cautery; and lately several cases have been reported in which success has followed these applications, although it is far too early to draw positive conclusions. As soon as the gangrenous nature of the disease has been established the operation must be performed. A loss of time, even of hours, means considerable loss of tissue. Again, delay may make the operation one of great magnitude, in that blood-vessels may have to be tied which before the extension of the process could be safely cut with the galvano-caustic knife. Under anæsthesia, when possible, necrotic tissue should be removed, and then everything that seems gangrenous should be destroyed. After this a certain amount of healthy tissue should be cauterized. If gangrenous spots appear the next day, the operation should be repeated, and so on; applications can be made daily. The wound is to be treated according to surgical rules, and plastic operations should be put off as long as possible, because, in the first place, they do not offer much chance of success when done early, and, in the second place, noma sometimes recurs as the result of these operations.

In conclusion, it must be stated that, whatever has been done and will be done, the results must be bad, because the process is one developed in a patient very much reduced, in whom the least complication is likely to prove fatal.

VI. Stomatitis Crouposa; Stomatitis Diphtheritica.

Croupous stomatitis may be produced by a variety of causes, both chemical and bacterial. Primary croupous stomatitis is certainly a very rare affection, although it may occur. As a rule, the croupous membrane develops contemporaneously with a membrane upon the tonsils. In very severe cases the membrane has been found upon the cheeks, the tongue, and even upon the lips. The lymphatic glands are not much involved, and as the mouth-process is commonly only part of another of more importance, little more will be said in this connection. The important thing to establish is the absence of the Loeffler-Klebs bacillus; this will make the diagnosis absolute. At the present time the whole subject is being investigated, but enough has already been done to show that all false membranes are not diphtheritic.

Diphtheritic stomatitis does occur as a primary affection, although it is

not very common. When primary in the mouth, the membrane usually develops upon the lips, and may extend thence to any part of the mouth. As a rule, the tonsil is the primary seat, and thence the membrane spreads to the soft palate, the tongue, the cheeks, the lips, and the gums. There is but one positive method of making the diagnosis of diphtheria, and that is by proving the presence of the Loeffler-Klebs bacillus by cultures, and then making inoculative experiments upon lower animals. In primary diphtheritic stomatitis this would become imperative; in the secondary form there are, fortunately, still left for the clinician combinations of certain symptoms that make it possible to diagnosticate the disease without consulting the bacteriologist.

Salivation usually occurs, and the odor from the mouth is fetid. Sometimes diphtheria of the mouth, when primary, runs it course most insidiously, and is overlooked or not recognized until further complications develop. The membrane lasts from three to six days, sometimes longer, and then either drops off or ulcerates away; in either instance there is left a denuded place. Hæmorrhages are common, either slight or otherwise; when not due to mechanical irritation they are matters of anxiety. In some instances hæmorrhage has been so great as to cause death; in others only a slight loss of blood seems sufficient to produce a fatal termination. The prognosis depends largely upon the form, whether primary or secondary; it is very much worse in the latter than in the former, but even in the primary form may become very grave by extension. The author has seen two cases in which a primary diphtheritic stomatitis has become a laryngeal one.

Treatment is that of diphtheria. When possible, the membrane must be removed if this proceeding be not accompanied by violence, so that infection of healthy membrane be produced. Constitutional treatment is of the utmost importance, in order to counteract the tox-albumins produced by the bacillus. For this purpose corrosive sublimate, administered internally in full doses frequently repeated, seems to be the favorite. In the septic cases much good can be done by frequent local applications without violence.

VII. Stomatitis Syphilitica.

Syphilis produces stomatitis only in an indirect manner, either by causing a specific deposit, which, in its turn, produces the disease, or by rendering the mouth in such patients more sensitive to agents which produce stomatitis.

The three stages of syphilis are developed in the mouth. Primary lesions are very rare, but infection does take place from syphilitic wet-nurses, and when this occurs the lesion in the mouth of the child does not differ from the same lesion in the adult. The secondary manifestations are most common, and any part of the mucous membrane may be their seat. Upon the lips we find the following forms: syphilitic fissures, papules, plaques, and erosions. The fissures (rhagades) are most common, and are generally found at the corners of the mouth or upon the upper and lower lips. They are syphilitic infiltrations which have been split near their middle, so that at the corner of the mouth one part of the infiltration lies nearer the upper lip, the other nearer the lower, and the split seems a continuation of the commissure. Upon the lip rhagades usually end in the mucous membrane. Sometimes these fissures are present in such great numbers that they disfigure the mouth, and by the pain which they produce cause great annoyance to the patient. When they heal they leave cicatrices which, in their turn, may permanently disfigure the mouth. The characteristics of these fissures are the infiltration, the split, and the lack

of tendency to spontaneous healing. Papules are most common at the commissure and the free border of the lips; they may also be split, and then resemble the former variety. As a rule they look like condylomata lata in similar positions; they are elevated, their surface is moist, the centre has a tendency to break down, and unless they involve the mucous membrane they do not cause pain. The remaining forms may be found upon any part of the mucous membrane; they cover more space, are not characterized by the same amount of infiltration, but usually produce more pain and more salivation.

Upon the tongue we most commonly find plaques muqueuses and syphilitic ulcers. Their localization depends largely upon irritation, either from a sharp tooth or other cause. The healed ulcers leave cicatrices, but the characteristic appearance of the tongue, as it is found in the adult after syphilis has run its course, is exceedingly rare in children. In the early stages of syphilis we find a decided enlargement of the circumvallate papillæ, and a loss of the filiform papillæ, so that the tongue looks "shaven." The so-called geographical tongue (wandering rash, ringworm, lichenoid condition) has nothing in common with syphilis and bears no relation to it.

Treatment.—As in all forms of syphilis, so with stomatitis syphilitica—general treatment is of most importance. When deformity or danger to life is threatened, that method must be used which produces the quickest effects. The manifestations in the mouth, as a rule, yield rapidly to constitutional treatment, but local prophylaxis and treatment must not be lost sight of, as being accessory and highly important. Cleanliness is absolutely necessary to prevent salivation as well as to aid in recovery. All sources of irritation must be removed and the teeth must be kept in good condition. Frequent applications of silver nitrate are best for ulcers, erosions, or losses of substance. Corrosive sublimate is preferable when there is considerable infiltration, either in weak solution as a mouth-wash, or in stronger solution applied with a brush, in which case it is apt to produce pain. The weak solutions should be applied two to four times daily; the strong ones (as high as 12 per cent.) are caustic and should be used with great caution. When children are old enough an application of emplastrum hydrargyri with lanolin (1 part of lanolin to 2 parts of the emplastrum) upon chamois gives better results than either of the former remedies in rhagades at the corners of the mouth. In cases of stomatitis mercurialis, potassium chlorate or any remedy containing tannic acid, such as tannin itself or tincture of rhatany or catechu, is very serviceable.

II. DENTITION.

Nearly all diseases of childhood have been ascribed to teething; even at the present time authors will be found who do not hesitate to work out the most improbable relations of teething to disease. But, be this as it may, there is no one who does not admit that some children may have teeth without any great amount of disturbance, or, indeed, that teething may go on without producing any symptoms at all. This latter form of teething would be called normal; the abnormal form has been called *dentitio difficilis*. It is proper to state that medical authorities are much divided as to the importance of teething as an etiological factor of disease, and that they can be divided into three classes: those claiming that almost any disease can be produced by teething,

those claiming that no disease is produced by teething, and, lastly, those who state that some few diseases may follow the eruption of teeth. The first class states that normal teething occurs in only 20 per cent. of all children. Although teething in healthy and teething in unhealthy children is a better division from a clinical standpoint, we will, for the present, follow the division as given above.

The greater part of teething is accomplished before the child is born. At about the seventh week of fœtal life the epithelium within the mouth is thickened, forms a ridge, and at the same time dips into the embryonic tissue about to form the jaw. This epithelial process is called the enamel-germ ; it grows so as to surround a flask-shaped cavity, which it lines ; partitions develop into this, forming ten cavities for each jaw. A papilla is now developed, which, pushing up toward the embryonic tooth, forms a complete mould for the enamel-germ to rest upon, and this is called the dentine-germ. We now have the beginnings of the ten temporary teeth in the form of the partitions, the enamel- and dentine-germ, and the papillæ. The connective tissue around these primitive teeth has at the same time been forming into the dental sac, an investing membrane for each tooth. In the partitions, as well as in the rest of the jaw, bony tissue is being formed; the teeth become farther separated from each other, and by this deposit of bone the alveolus is formed, lined by the dental sac coherent with the gum along the border of the jaw. This process of development has taken the whole period of fœtal life, so that the child comes into the world with all its temporary teeth fully formed within the jaw. The permanent teeth are formed, in so far that the enamel-germ is developed from the enamel-germ of the temporary tooth as a small sac, from which subsequently the development goes on, as already described for the temporary teeth. The topographical relations of the teeth at birth are as follows: above, the tooth-sac, the submucous connective tissue, and the mucous membrane itself; on either side, the tooth-sac and bony tissue. There is no bony tissue to impede the tooth on its way to the oral cavity ; all that it needs to overcome is the submucous coat, the mucous membrane, and the dental sac, which is very thin. Not enough stress can be laid upon the fact that the opening of the alveolus is wider than necessary to allow the tooth to pass through.

Calcification of the fangs begins, and as the tooth becomes elongated by means of this, it is slowly forced in the direction of least resistance, the mouth. Pressure is directed toward the mouth ; the papilla cannot be pressed upon, for the simple reason that where, during growth, blood-vessels come in contact with bony substances, absorption of the latter is produced, the blood-vessels not being affected. It is possible that, as Kassowitz has pointed out, the growth of the blood-vessels causes the alveolus to be moved constantly, and that this growth acts as another cause for the coming through of the teeth. Calcification of the fangs usually begins in the lower incisor teeth at birth, beginning in those teeth first which are first to make their appearance in the mouth.

The order of teething can be described as occurring in three ways. Unfortunately, there is as yet no unanimity among authors as to the most common method. The first is the appearance of the teeth in pairs, principally in relation to the incisors. The second is the appearance of the first *two* incisors, then all the other incisors, and then the molars. The third, which we believe to be the most common order, is the appearance of the first two lower incisors, then the four upper incisors, then the first molars, and with them the remaining two lower incisors, as follows:

I. Two lower central incisors	5– 7	months.
II. Four upper incisors	8–10	"
III. Four first molars and two lower lateral incisors	12–14	"
IV. Four canines	18–20	"
V. Four second molars	28–34	"

It will be borne in mind that this table represents average times, and that the time for eruption depends upon a great many different causes. The nationality, heredity, climate, and general development of the child may either retard or accelerate the appearance of teeth. Certain diseases, especially rickets, have a well-marked retarding influence, but because a child is late in teething it must by no means be taken as positive evidence that he has rickets.

The time of eruption depends, first, upon the distance the tooth has to travel from the dental sac to the mouth; secondly, the amount of calcification in the fangs; and, lastly, the condition of the rudimentary organs. Increased calcareous deposit would compensate for length of distance, and possibly for deficiencies in the rudimentary organs; but frequently no compensation can take place, and the teeth are left permanently deformed as well as late in appearing.

Premature teeth may occur from several causes: some change in the embryonic structure may result in the production of teeth without fangs, which are attached only by mucous membrane; or the deposit of calcareous material may be too early or too great; or, finally, more than twenty primitive teeth may have been formed, one or more of which project into the cavity of the mouth. Premature ossification of the bones of the skull is said to be accompanied by premature teeth, and in this case Jacobi claims that the upper incisors then appear first. The latter view, however, still requires verification. Premature teeth must not be interfered with unless there is a special indication for their removal, because it may be possible that no second tooth shall appear until the permanent one comes through; and, furthermore, their removal is not unattended by danger (hæmorrhage). The most urgent indication for removal is to be found in their being in the way of nursing; they may produce fissure of the nipples or may make nursing so painful to the mother that serious consequences follow.

The teeth are retarded by the constitutional diseases, rickets and syphilis—these forms of general disturbance of nutrition resulting in cachexia and in long-continued fevers or chronic diarrhœa. Acute febrile disturbances, such as the exanthemata, may not have any effect upon the temporary teeth, and yet show distinct tracings upon the permanent teeth; or the group coming through at the time of fever may not be delayed at all, and yet the next one will be delayed some time.

A food-supply defective in calcareous material has been frequently accused of delaying teething. This is, theoretically, correct; but, as a matter of fact, when the salt material of the food is diminished to such an extent as not to be able to supply the small amount demanded for teething, life can no longer be sustained by such food. Our own experience has been that none of the proximate principles of which teeth are composed, when administered internally, have any effect upon the appearance of the teeth. There is but one remedy which seems to hasten teething, and that one affects rachitic children principally, though not exclusively; we refer to the internal administration of phosphorus.

The permanent teeth appear in about the following order and times:

First Molars.	Incisors.	Bicuspids.	Canines.	Second Molars.	Third Molars.
6 years.	7–8 years.	9–10 years.	12–14 years.	12–15 years.	17–25 years.

In regard to the symptoms produced by teething, it can be definitely stated that in a healthy child teething goes on without producing symptoms of any sort. In children reduced by malnutrition, affected by hereditary syphilis or rickets, and in those extremely nervous either as a result of hereditary or other causes, there are symptoms which can be divided into two groups: first, local; secondly, remote. The local symptoms are pain, heat, irritation, not infrequently stomatitis catarrhalis. All these may occur in healthy children, but are manifestly of little importance, as they produce little if any general reaction, and are certainly very rare. At times children may become a little fretful or cross, and in the evening have a slight rise of temperature. As a rule, however, the teeth which have long been expected by the anxious watchers make their appearance without premonitory signs, so that the wise physician will hesitate before he prophesies when a tooth is to appear. Salivation cannot be looked upon as a symptom of teething, as it usually occurs from two to three months before the first incisors appear, and is physiological. The salivation occurring during teething is due to stomatitis. The pain can only be very slight, and can be judged by analogy with that produced during the appearance of the second teeth. In an unhealthy or over-sensitive child this, however, may be sufficient to produce restlessness or peevishness. That the pain cannot be very great must be accepted also from anatomical facts: the nerve-filaments covering the tooth have either been absorbed or rendered insensitive by continuous pressure upon them. The papilla cannot be taken into consideration at all, as it has been shown that the teeth could not in any way press upon it.

The symptoms in remote parts have to be analyzed carefully, and much cool judgment may be required to find their cause. The tendency at the present time is to accept fewer and fewer symptoms as due to teething; but for convenience we have grouped them under the following headings: symptoms on the part of the nervous system, the digestive apparatus, the skin, the respiratory apparatus, the genito-urinary system, and the organs of special sense.

The principal symptom on the part of the nervous system, still adhered to by many, is convulsions. It is claimed that they are of a reflex kind, the tooth being the irritant producing an abnormal afferent impulse to the medulla. Theoretically, this can be taken into consideration, but in practice convulsions are not produced by teething, least of all as the result of a reflex mechanism. Tonic contractions of muscles of a local nature may easily be produced by an increased afferent impulse, but the most painful lesions involving the fifth pair of nerves in the reflex arc are not followed by generalized muscular contractions. In the alimentary canal we find the bowels participating in the general hypersensibility of the child. There is no evidence to show that bowel lesions are produced by teething, either as the result of swallowing an imaginary excess of saliva or otherwise. The most pernicious doctrine that exists is the one that intestinal disease is due to teeth. An over-fed or badly-fed child—and at the time of the eruption of the canines it is most liable to be both—if suffering, generally has an irritable intestine; and very likely substances which should not enter the circulation may pass into it from the intestine, and the result will be stools changed as to quantity and quality. This, in the latter instance, is a curative act, and disappears as soon as the diet is corrected. There is nothing characteristic about this form of diarrhœa; it rarely becomes pathological, and may be helped along by the administration of a laxative. Any diarrhœa, however, occurring at any time during infancy should be

watched, whether the child is supposed to be teething or not, and, the cause being removed, the bowels should be "checked." It is important to disregard teething entirely in long-continued diarrhœa, and to look to the food or other known agencies for the cause.

On the part of other organs the symptoms which occur must be looked upon as concomitant with teething and not caused by it.

Some have claimed that teething does not, *per se*, make children sick, but that it predisposes them to illness. Predisposition to disease undoubtedly exists, both temporary and permanent, but it is a difficult thing to establish, and, from what we know at present, such a theory must be denied absolutely as far as teething is concerned.

There is no treatment for teething, as it requires none. The healthy child has no symptoms to manifest any diseased condition, because there is no disease. The unimportant symptoms that may occur are to be treated purely symptomatically. The restlessness, where necessary, will be relieved by bromides. The various forms of stomatitis are to be treated by the appropriate remedies referred to in another place. Bowel troubles require rigid diet, always a proper precautionary measure in all forms of intestinal disturbances. Beyond this nothing is required.

Gum-lancing or gum-scarifying is looked upon by many as the specific method of treatment for teething ailments. The indication for the operation is to relieve pressure. The tooth has been supposed to press in any or all directions, and by means of this pressure to produce the baneful results referred to. Some authors claim that the pressure is exerted upon the mucous membrane; others, upon the dental sac; others, upon the alveolus; and finally others, upon the "sensitive" papilla. Accordingly, each one has a peculiar method to recommend for the operation. From a practical standpoint any of these methods can do good in only one of two ways—either as a method of blood-letting or as a suggestive remedy; but either indication can be met by simpler means. From a theoretical standpoint everything is against any such method of operation. It has already been shown that the papilla cannot be pressed upon, and that the opposite condition exists: the papilla is forcing the tooth. All this in the growing tooth is done so gradually, however, that very little pressure is exerted in any direction. The mucous membrane cannot be accused of suffering, for, as we have seen, movement of the teeth toward the oral cavity practically begins at birth. Given any mucous membrane which has been pressed upon by a rigid substance for from five to seven months, and atrophy will undoubtedly follow—atrophy of the membrane and all its component parts, including the nerves. For the same reason pressure upon the dental sac would be impossible. Pressure upon the bony walls is out of the question, because there is ample room in all directions for the tooth, the opening of the alveolus being especially large, so that the crown of the tooth can pass without difficulty.

It cannot be denied that indiscriminate gum-lancing does harm. Hæmorrhage is its greatest danger: we have collected twelve fatal cases, and it is not overstating the matter when we say that many more have occurred that have not been recorded. Behrend, Churchill, Barthez and Rilliet, and Finlayson refer to the danger to children arising from anæmia as a result of this operation—a danger that cannot be expressed statistically. Under normal circumstances the pushing through of a tooth does not leave a wound of any sort: there are no lymphatics, no blood-vessels opened, these having been closed by the process referred to before. Every time a gum is lanced an open wound is produced—fortunately, one which, under ordinary circumstances, heals

quite rapidly. But with the mouth as a playground for many pathogenic microbes the danger of infection must not be under-estimated.

In conclusion, I wish to emphasize the following points: I. Gum-lancing is useless, *a*, as far as giving relief to symptoms; *b*, as far as facilitating or hastening teething. II. It is useful only as bloodletting or as a suggestion, and ought not to be used as such. III. It is harmful, *a*, in producing local trouble; *b*, in producing great disturbance on account of hæmorrhage; *c*, in having established a method which is too general for specific good and too specific for universal use. IV. It is to be used only as a surgical procedure to give relief for surgical accidents.[1]

[1] The author certainly presents in a very forcible manner one side of the disputed question of the advisability of gum-lancing. That too many aberrations from health are laid to the score of teething, and that lancing is often performed heedlessly, unnecessarily, and even injuriously, cannot be questioned, yet there are many well-informed physicians and clinicians who use the lance in appropriate cases, because experience—the crucial test—has demonstrated its utility. In this class the Editor must be included.—L. S.

DISEASES OF THE PHARYNX AND NASO-PHARYNX.

By W. E. CASSELBERRY, M. D.,

Chicago.

I. Acute Pharyngitis and Naso-pharyngitis.

The posterior wall, the vault, and the lateral angles of the pharynx, the pillars of the fauces, the velum palati, and the tonsils may be, each alone or all together, the seat of an acute inflammation of the mucous membrane, which for convenience is commonly designated simply as "pharyngitis."

Predominant inflammatory diseases of the tonsils, however, are considered apart under appropriate titles, although tonsillitis of a superficial type is often a detail only of diffuse simple pharyngitis, and may then be included in the latter term. The forms of symptomatic pharyngitis which are incidental to the exanthemata are excluded from consideration at this point.

Etiology.—The predisposing conditions are chronic hypertrophy of the faucial and naso-pharyngeal tonsils, acute or chronic rhinitis, previously existing chronic pharyngitis, and digestive disturbance. Climatic inequalities, with exposure to chilling influences, furnish adequate exciting causes.

Pathology and Symptoms.—Hyperæmia may be so pronounced and so diffuse as to lend a bright reddish hue to the entire oro-pharynx, or, on the other hand, only limited spots of congestion may be noticeable. Often the pillars of the fauces alone are implicated.

The posterior surface of the velum palati is a frequent point of attack, and, indeed, the disease not infrequently embraces the rest of the naso-pharynx, and occasions an amount of pain and discomfort located high up which is far in excess of that which can be explained by inspection of the fauces only. More explicitly speaking, naso-pharyngitis may be conjoined with pharyngitis.

After the first twenty-four hours thickening and relaxation of the mucosa, with swelling and œdema, especially of the velum and uvula, is associated with the hyperæmia, and the disease culminates at times in chronic relaxation of the velum and elongation of the uvula. The secretion is at first diminished, the patient complaining of "dryness," but later there is an excess of viscid mucus.

In childhood the acute folliculous variety of pharyngitis is very common; that is, the isolated muco-lymphoid glands which are scattered over the posterior wall of the pharynx are especially the centres of inflammatory action.

The patient complains of a constant sense of discomfort, which necessitates frequent acts of deglutition, which are positively painful, although actual swallowing of food is rarely painful except in severe forms of the disease. There is but little systemic derangement in uncomplicated cases.

Diagnosis.—Critical inspection of the pharynx by means of a good light, preferably light reflected from a concave mirror, will establish the diagnosis by

correspondence with the signs above described. In the first twenty-four hours it may be difficult to distinguish simple pharyngitis from the symptomatic pharyngitis of scarlatina, the preliminary pharyngitis of diphtheria, the first stage of acute infectious phlegmon of the pharynx, and pharyngeal erysipelas. The presence of high temperature, perhaps following a distinct chill and accompanied by pronounced systemic derangement, should cause one to anticipate future developments.

Prognosis.—Recovery is hastened by treatment, but in uncomplicated cases it would naturally ensue within ten days. It is supposed that simple pharyngitis may predispose a child to infection by the bacillus diphtheriæ and other pathogenic micro-organisms.

Treatment.—In mild cases a simple gargle of potassium chlorate, ten grains to the ounce, every two hours, is sufficient. This may be made more effective when greater astringency is desired by the addition of tannic acid two grains to the ounce. A variety of other astringents are also available.

In severer cases, especially those which are conjoined with naso-pharyngitis and rhinitis, it is important first to cleanse the entire area by spraying or gargling with an antiseptic alkaline solution:

℞. Sodii boratis . . . . . .
Sodii bicarbonatis . . . . . āā gr. xx.
Ol. eucalypti . . . . . ♏j.
Thymol . . . . . gr. j.
Menthol . . . . . gr. ss.
Ol. gaultheriæ . . . . . ♏j.
Glycerini . . . . . fʒss.
Alcoholis . . . . . fʒj.
Aquæ . . . . . q. s. ad fʒj.—M.

Sig. Dilute, adding one or two fluidrachms to one fluidounce of water, for use as a spray or gargle.

Young children cannot gargle, and are often terrified by spraying, in which case one may project, through each nostril into the throat, a half-drachm of this diluted mixture by means of an ordinary glass medicine-dropper. After thus cleansing the parts the same astringent gargle may be used; or with larger children and in the hands of the physician, an astringent spray, preferably of the sulphate of iron and ammonium, three to five grains to the ounce, may be applied to the pharynx, and, if need be, by an upward spray-tip to the naso-pharynx. The astringents should never be projected through the nose. In painful cases much comfort and some benefit follow spraying by a 1 per cent. solution of cocaine hydrochlorate, and with especially irritable throats its preliminary use will permit subsequent topical applications to be made with greater ease.

When necessary, minute quantities of cocaine may be used in the form of a lozenge, as in the following formula, recommended by Bosworth:

℞. Cocainæ muriatis . . . . . gr. v.
Ext. krameriæ . . . . . gr. ij.
Sodii bicarbonatis . . . . . gr. xv.
Ext. glycyrrhizæ . . . . . ʒiiss.—M.

Ft. massa in trochisci No. xxx div.

In office practice as a final spray, or for self-medication, even alone or

following an astringent gargle, we find the following emollient very soothing to highly inflamed mucous surfaces:

℞. Ol. pini Canadensis . . . . . ♏ v.
Ol. eucalypti . . . . . ♏ ij.
Ol. gaultheriæ . . . . . ♏ ij.
Thymol . . . . . gr. ss.
Menthol . . . . . gr. j.
"Vaselin oil" . . . . . q. s. ad f℥j.—M.
Sig. Use with a double-bulb atomizer.

A laxative is usually indicated, even though the bowels may be stated to be regular. Apart from this, little constitutional treatment is required, other than may seem appropriate for any associated conditions.

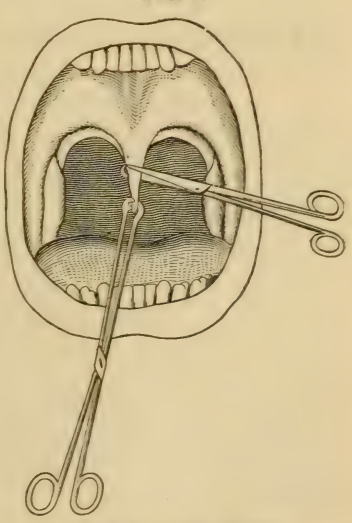
II. Simple Chronic Pharyngitis; Elongation of the Uvula.

Simple chronic pharyngitis occurs but rarely in childhood, and is then dependent upon diseases of the nose, tonsils, or digestive organs, and the most rational line of treatment, and the only one likely to result successfully, is that indicated by the primary affection. The same is true in part of elongation of the uvula, but only in part, since radical treatment directed to this organ will occasionally be required.

Relaxation of the velum palati and paresis of its muscles are usually associated with lengthening of the uvula, and the disability is due to chronic or recurrent acute inflammation of the nose, naso-pharynx, or pharynx. Frequent necessity to dislodge mucus by "hawking" is somewhat instrumental in its production.

Symptoms.—The chief symptom is a harassing cough, which is found especially annoying on retiring and rising and at times of acute inflammation of the throat. It often causes the child to be treated indefinitely for bronchitis or other invisible disorders, when a critical inspection of the pharynx in a state of quietude would disclose the palate lying on the base of the tongue. Extreme elongation has even served to excite attacks of laryngismus stridulus. Rarely the uvula is bifid, a congenital defect which predisposes it to elongation.

Fig. 1.



Abscission of the Uvula.

Treatment.—Concerning the treatment, palliation may be secured, even cure in recent cases, by an astringent spray or gargle. More often this will fail to produce wholly satisfactory results, and then attention must be given to whatever abnormality underlies the elongation of the uvula; if the tonsils be hypertrophied, they should be abscised; if there be naso-pharyngeal adenoid hypertrophy, it should be removed, etc. If the difficulty then continue, one should not hesitate to abscise the surplus portion of the uvula, leaving it of normal length. It is most quickly done by a uvulatome fashioned on the principle of a tonsillotome, but can readily be accomplished by forceps and scissors. (Fig. 1.)

III. Chronic Follicular Pharyngitis.

Although, as previously stated, simple chronic pharyngitis occurs but rarely in childhood, chronic follicular pharyngitis is not uncommon. It is characterized by enlargement of the isolated muco-lymphoid follicles which are scattered over the posterior wall of the pharynx and arranged in a chain in each lateral angle of the throat behind the posterior pillar. These are single follicles of the same histological structure as the tonsils, which are compound glands. It is natural, therefore, that they should become hypertrophied in response to the same underlying dyscrasia—lymphatism—which predisposes patients to hypertrophy of the tonsils and of the naso-pharyngeal adenoid tissue. Indeed, in children the disease is usually conjoined with the latter pathological states. Symptoms are manifest only in pronounced cases, and then, usually, at times of an acute exacerbation. A constant tendency to "hawk," a sense of discomfort, and, in rare instances, a sense of a foreign body in the throat, are the most important. On inspection one observes small round eminences dotted irregularly over the posterior wall of the pharynx, and ridges of reddish hue in the lateral angles. The latter aspect of the disease, when especially marked, has been designated, in recent works, pharyngitis lateralis.

Treatment.—The enlarged follicles should be destroyed by touching each one with the galvano-cautery point-electrode. Three or four may be cauterized at each sitting, and several sittings will be required. The result is very satisfactory. When tonsillar and naso-pharyngeal adenoid hypertrophy is also present, this condition should first be removed, in which case further treatment often becomes unnecessary.

IV. Acute Follicular Tonsillitis.

The infectious nature of most cases of follicular tonsillitis is now definitely established: yet other cases are, seemingly, of simple catarrhal origin, devoid of pathogenic germ infection; it is therefore evident that one can distinguish, and should describe, at least two forms of this disease: infectious pseudo-membranous tonsillitis and simple follicular tonsillitis.

Infectious Pseudo-membranous Tonsillitis

is also termed "croupous tonsillitis," "tonsillitis lacunaris," "diphtheritic sore throat," and "pseudo-diphtheria," although the latter term has been indiscriminately applied also to scarlatinous diphtheria and to all forms of membranous pharyngitis not caused by the Klebs-Loeffler bacillus.

Etiology.—The infectious nature of certain forms of acute follicular tonsillitis has long been suspected, yet the fact has not been generally credited, for the reason that when the clinical evidence of infectiousness was conclusively present the disease would be attributed to diphtheritic origin or the subject be dismissed as a mere coincidence. We now know that the true *bacillus diphtheriæ* is not present in this disease, but that the form described under the name of infectious pseudo-membranous tonsillitis, or croupous tonsillitis, is caused by local infection by any one of several species of pathogenic micro-organisms: *e. g.* streptococcus erysipelatosus, streptococcus pyogenes, staphylococcus pyogenes aureus, staphylococcus albus, etc.

Symptoms.—Infectious pseudo-membranous tonsillitis is characterized by deep congestion, but often only by moderate swelling of the tonsils and by a punctated exudate of pseudo-membrane, the spots of which are in size from 2 to 4 mm. in diameter, and are attached around the follicular openings, pre-

senting the appearance as if the crypts were also lined by the same material; unlike the cheesy pellet, the exudate in its typical form is thin, translucent, and intimately connected with the underlying mucosa. Two or more puncta may join at their borders and form larger spots, but after cleansing away all muco-purulent matter this punctated conformation of even the larger areas may be readily discovered (Fig. 2). In addition to the tonsils, any or all of the muco-lymphoid glands in the pharynx may be likewise affected, especially the chain of glands located just behind the tonsil and separated from it by the posterior pillar; but the pseudo-membranous exudate is limited absolutely to the glandular structures of the pharynx, although careful cleansing and critical inspection will be required to demonstrate this fact.

The attack is ushered in by chilly sensations, perhaps preceded, for a day or so, by malaise, and followed by a temperature of 102° to 105° F., with consequent febrile symptoms. After one to three days the temperature falls materially; the pain, which has been quite severe, gradually ameliorates, and within one week convalescence is established. The cervical lymphatic glands are often secondarily infected, as evidenced by swelling and tenderness, which last for two or three weeks. Suppurative cervical adenitis and cellulitis may follow in rare instances. Transient albuminuria is an occasional complication.

FIG. 2.



Acute Infectious Pseudo-membranous Tonsillitis (follicular). The two whitish points on the posterior wall represent exudate formed on isolated muco-lymphoid follicles.

Diagnosis.—The opinion of bacteriologists that in these affections diphtheria can only be excluded positively by the absence of the Klebs-Loeffler bacillus, as determined microscopically, is doubtless correct as applied to rare border-line cases; but commonly a differential diagnosis can also be made with greater promptness and with reasonable certainty from the macroscopic signs and clinical symptoms.

True diphtheritic exudation may commence at the orifices of the crypts of the tonsil, but does not long remain limited to the tonsils and muco-lymphoid glands of the pharynx, as does the exudate of tonsillitis. The diphtheritic membranes will extend within twenty-four hours to the pillars, velum, or pharyngeal wall. The exudate of tonsillitis is thin, and not materially raised above the surface; it is white, translucent, and presents a living, clean aspect devoid of necrotic change; while the exudate of diphtheria is thickish or protruding from the surface, opaque, and dirty-yellow or rapidly becoming so—appearances indicative of necrotic change.

The exudate of tonsillitis is punctated, the spots corresponding to the follicular openings, and, while two or more puncta may join at their borders and form larger areas, after careful cleansing, critical inspection, under thorough illumination, will disclose this punctated conformation, which distinctly differs from the diffuse plaque of diphtheria, even when, for the time being, the diphtheritic exudate occupies the tonsil alone.

SIMPLE FOLLICULOUS TONSILLITIS.

With the simple form there may or may not have been previous chronic

hypertrophy or inflammation: it is conditioned, if not caused, by "taking cold," *i. e.* by refrigeration of some part of the body surface, which determines vascular engorgement of the tonsils, exactly as in another individual it may occasion vascular engorgement of the nasal turbinated bodies. The tonsil swells, the follicular openings are obliterated and the pent-up secretion acts as a further irritant; it becomes inspissated and mixed with epithelial débris; it is soon forced out to the surface of the gland in the form of "cheesy" pellets, which are altogether different from a pseudo-membrane, and which protrude from the narrowed follicular openings. Finally, when the tonsils are free of this accumulated débris, or at times earlier if the globules are forcibly dislodged and removed, the tonsillitis rapidly subsides. It is not usually preceded by a distinct chill, and not accompanied by much fever or systemic depression. It is without evidence of primary parasitic infection as a cause, and therefore not contagious; it is capable, however, of being transposed into a conglomerate variety of tonsillitis by secondary infection with pathogenic micro-organisms, thus becoming contagious.

In fact, between these two types of tonsillitis are observed numerous cases of mixed variety which present all degrees of approximation to one or the other type.

General Treatment.—The rheumatic diathesis is frequently associated directly or indirectly with tonsillitis, in which case salicylate of sodium or salol should be administered internally. Otherwise, the tincture of the chloride of iron, 1 part to 10 parts of glycerin, may be administered every hour without further dilution in the dose proportionate to the age of the child, both for its local effect, as it is diffused over the fauces in swallowing, and for its systemic influence.

For the high febrile action of the first day or two we have been accustomed to give minute doses of tincture of aconite, conjoined with potassium bromide, disguised in solution by a few minims of spirit of peppermint, and to which may be added very small quantities of morphine if it is needed to control pain.

Of late years, antipyrine or phenacetin has been often substituted advantageously for the aconite and bromide mixture. A saline laxative is nearly always needed.

Local sprays by a hand-atomizer are of the greatest benefit when the child is old enough to tolerate them. An alkaline and antiseptic lotion (See Acute Pharyngitis) is to be preferred. This should be sprayed every three hours through the mouth, and also through the nose, into the naso-pharynx, thus cleansing that cavity, as well as the fauces, of the viscid muco-purulent matter which accumulates and conduces to much discomfort.

Hydrogen peroxide, diluted to the point of freedom from production of smarting sensation, is also an excellent local spray, especially if used alternately with the one above mentioned; and either or both of these may be used following a preliminary spray of 1 per cent. solution of cocaine hydrochlorate, which serves to control pain and super-irritability of the fauces.

Generally speaking, it is best to avoid the use of cotton swabs and brushes. Gargles may be substituted for sprays when necessary, or made to supplement spraying, and for use as a gargle the formula for spray above referred to should be diluted doubly as much as for use in a spray.

With very young children the naso-pharynx and fauces can be readily cleansed by the same solution freely diluted, warmed, and injected gently in small quantities by a small syringe or an ordinary medicine-dropper through the nares.

V. Peritonsillar Abscess, or Suppurative Tonsillitis.

This condition is also termed acute parenchymatous tonsillitis, phlegmonous tonsillitis, quinsy, etc., but of these terms the best is peritonsillar abscess, because it is descriptive, since the suppuration does not occur in the tonsil itself, but in the cellular tissue around it or above, behind, in front, or to the outer side of the gland. The disease is comparatively rare in early childhood, but about 3 per cent. of all cases occur under ten years, and about 6 per cent. under fifteen years, of age.

Etiology.—The direct cause of suppuration here, as elsewhere, is infection by specific pathogenic micro-organisms from some source, either from within or without the body.

The predisposing causes are exposure, the rheumatic diathesis, chronic tonsillitis, and acute follicular tonsillitis.

Symptoms.—A chill or chilly sensation is followed by a temperature of 102° to 105° F., and consequent febrile symptoms. About the same time a sense of soreness and fulness is perceived in one side of the throat, followed by lancinating pains which dart through to the ear, and, later, by a deep-seated throbbing pain as suppuration ensues. On inspection the swelling is seen to extend to the median line of the throat, and even far beyond, in severe cases projecting upward into the naso-pharynx and downward along the side of the pharynx, sometimes leaving only the smallest chink available for respiration and deglutition. The latter function is painful, and the diet must be confined to liquids, for the reason, also, that the lower jaw is "set" so that the mouth can be opened only about half an inch.

Viscid mucus accumulates in the partially occluded pharynx and in the naso-pharynx, causing suffocative attacks and necessitating painful efforts to clear the throat. Indeed, for a night or two the patient cannot assume a recumbent position or sleep uninterruptedly, as voluntary efforts are required to maintain patency of the throat. The uvula becomes œdematous, and the opposite tonsil is usually somewhat swollen, often suppurating later, although simultaneous suppuration of the two sides is rare.

Diagnosis.—During the first twenty-four hours the disease cannot be distinguished with certainty from follicular tonsillitis, which, indeed, often precedes the peritonsillar abscess. Later, the diagnosis is established by the characteristic distortion of the throat, as represented in Fig. 3, in which it is seen that the tonsil itself is not the chief seat of swelling, but that this gland is projected inward by tumefaction in the cellular tissue of the velum palati.

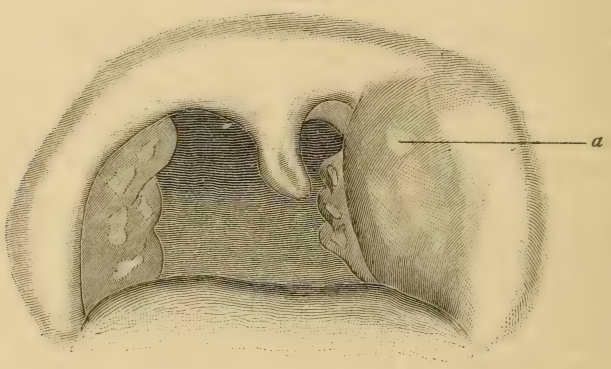
Prognosis.—This is favorable, except in cases of rare complications, such as œdema of the larynx, extensive burrowing of pus, or hæmorrhage.

Treatment.—During the first twenty-four or thirty-six hours an effort should be made to abort the disease, and to this end the internal and local medicinal treatment is much the same as that described for follicular tonsillitis—a saline laxative, the immediate administration of salicylate of sodium in full doses because of the common dependence of the disease on the uric-acid diathesis, and tincture of aconite with potassium bromide as an adjuvant. The same alkaline and antiseptic spray which is recommended for follicular tonsillitis should be used every hour or half-hour, and in the same manner, spraying through the mouth, and to a less extent through the nose. In the early stage of the affection the application of cold externally by means of Leiter's coil would assist in aborting the suppurative inflammation were it as feasible with restless children as with adults. As soon as it becomes evident that sup-

puration must occur, a hot poultice, applied externally over the corresponding part of the neck, will both ease the pain and hasten the formation of pus.

At the earliest moment that pus is indicated with reasonable certainty by fluctuation or an effort at "pointing" the abscess should be punctured, preferably by a long, slightly curved, double-edged bistoury devised for the purpose, or, in the absence of this instrument, by an ordinary sharp-pointed bistoury. The puncture should not be made into or through the tonsil itself, but somewhat above and to the outer side of the gland into the anterior surface of the velum, where the pus actually is located, in the cellular tissue of the velum palati and palato-glossal fold (Fig. 3).

FIG. 3.



Peritonsillar Abscess: *a*, point for puncture.

VI. HYPERTROPHY OF THE TONSILS.

The exact function and size of normal tonsils are questions of interest which are answerable only in a general way. Histologically, they possess the structure of both a lymphatic and a mucous gland, and, anatomically, they are in close connection by lymph-channels with the cervical lymphatic glands. The inference is that they are lymphatic glands, possessing the function of similar glands elsewhere located, which by virtue of their position in the fauces have been endowed also with mucous elements for lubricating purposes. The natural size approximates that of an almond-kernel.

Etiology and Pathology.—The predisposing cause of enlargement of the tonsils is a peculiar diathesis now termed "lymphatism," the local manifestations of which include also enlargement of the naso-pharyngeal tonsil, or "adenoids," and of the muco-lymphoid glands of the pharynx and base of the tongue. This diathesis is certainly not identical with scrofula, even in the limited sense to which that term is now restricted, for lymphatism frequently manifests itself in children who are otherwise robust, yet the condition seems allied to, and often conjoined with, scrofula. Climatic inequalities furnish adequate exciting causes.

In the usual form of the disease, that of mere hypertrophy, there is simply an overgrowth, both in size and number, of all the natural elements of the gland—the lymphoid bodies, crypts and follicles, mucous glands, and connective tissue.

Another variety of hypertrophy of the tonsils, named by Bosworth the hyperplastic form, which is rare in children, but common in adults, results from repeated attacks of acute inflammation and consists chiefly of hyperplasia of

the fibrous connective-tissue element, with a less degree of enlargement and multiplication of the lymphoid bodies. Such tonsils are dense and fibrous, while those of the first type are soft and friable. Between these two types, exist all degrees of variation, both in contour and texture.

Symptoms.—Moderate enlargement only will occasion a tendency to recurrent attacks of acute tonsillitis, and any degree of hypertrophy unquestionably predisposes the child to diphtheritic infection and increases the gravity of the latter disease when it occurs.

The effects of mechanical obstruction to respiration occasioned by enlarged tonsils, either alone or especially in conjunction with enlargement of the naso-pharyngeal tonsil, will be described in the article on Naso-pharyngeal Adenoid Hypertrophy, and I need only mention here the more prominent features.

Mouth-breathing can be caused even by enlarged faucial tonsils alone—by their projection backward and upward into the pharynx in such a way as to interfere with the passage of air inspired through the nose. Mouth-breathing in turn causes deformed development of the facial bones and muscles and an idiotic expression of countenance and mental stupidity; also, deformed development of the chest and thoracic weakness. The recumbent position and absence of voluntary muscular control to keep the throat open aggravate the obstruction to both nasal and oral respiration at night, so that the patient is frequently awakened or thrown into a nightmare by a sense of dyspnœa. Deglutition and mastication are impaired in proportion to the extent of the disease, although it is probable that deficient oxygenation of the blood and disturbed rest at night, together with subsequent thoracic deformity, are the chief factors in seriously stunting the development of the child.

Treatment.—Abscission is the only satisfactory method of treatment when the enlargement is sufficient to occasion the symptoms of mechanical obstruction.

It is probable that the syrup of iodide of iron so far tends to correct the underlying constitutional dyscrasia as to prevent recurrence after operation, and even to cause partial reabsorption of very slight and recent overgrowths; but we have never been able to discern therefrom any permanent reduction of tonsils which were greatly or even moderately enlarged. Local astringents are wholly inadequate. Ignipuncture or galvano-cautery puncture affords only palliation for the milder cases. We have repeatedly found it necessary to abscise tonsils after months had been spent with this somewhat painful and ineffective mode of treatment.

The wire snare is an excellent means of abscission when the child is anæsthetized, as when combining this operation with that for "adenoids;" but otherwise it is slow and painful, and, like the galvano-cautery snare, it requires more time and quietude for adjustment than are available with young children when not anæsthetized. An anæsthetic is not usually necessary when the faucial tonsils alone are to be abscised, although it is decidedly best to administer ether when the combined operation for removal of the faucial tonsils and naso-pharyngeal "adenoids" is to be made. Also, with unusually excitable or obstreperous children ether may be administered.

The tonsillotome is still the best implement for children who are not anæsthetized, because of the rapidity, precision, and comparative ease with which this method can be practised. With older children it is best to use a preliminary spray of 5 per cent. cocaine solution. Younger children are apt to be terrified by spraying, and it is best to omit it. The pain is not really great.

The Mathieu tonsillotome is well adapted to the purpose, especially for children, and it is the one now in general use. The mechanism is very

ingenious, being fitted with a fork attachment which is designed to transfix the tonsil, and withdraw it from its bed by the same motion of the operator's fingers which draws the ring-knife home. The much-vaunted Mackenzie tonsillotome is an unnecessarily cumbersome instrument.

The author has described elsewhere a simplified instrument which he has

Fig. 4.

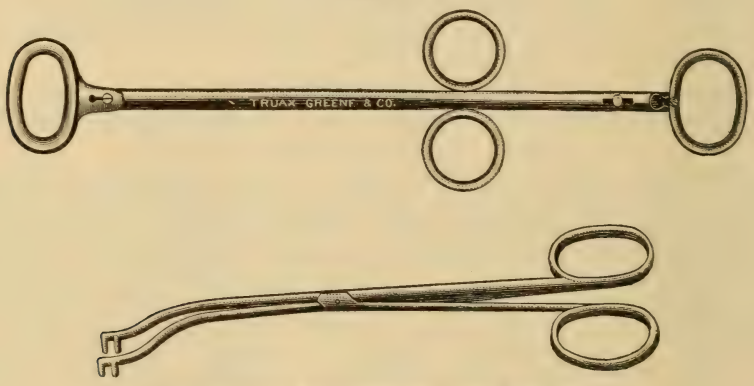


Mathieu's Tonsillotome.

used for years with the utmost satisfaction. It is the Mathieu guillotine, so constructed as to do away with the fork attachment (Fig. 5).

In place of the fork he uses, held in the other hand, a specially constructed vulsellum (Fig. 5), by which the tonsil can be grasped, drawn out of its bed, and abscised at the point desired with much greater accuracy than by the fork attachment (Fig. 6). He has found the action of the fork to be largely accidental, dependent on the size and shape of the tonsil and the amount of gagging by the patient—that now it determines too deep an

Fig. 5.



The Author's Tonsillotome and Tonsil Vulsellum.

abscission, and, again, misses the tonsil entirely, especially if this happens to be rather small or flat. In other words, the new instrument, assisted by the vulsellum, will abscise many tonsils that could not be satisfactorily grasped by the old mechanism, and it will abscise all tonsils with a reasonable degree of accuracy at the proper line.

One can also by this instrument more easily avoid wounding the anterior and posterior pillars, which eliminates one of the sources of persistent hæmorrhage. The instrument therefore conduces to safety by virtue of greater possible precision in operating. It is less formidable in appearance and is easy to use. No tongue-depressor is necessary, the body of the tonsillotome answering this purpose, at the same time that the vulsellum prongs grasp the tonsil to draw it from its bed into the ring of the tonsillotome.

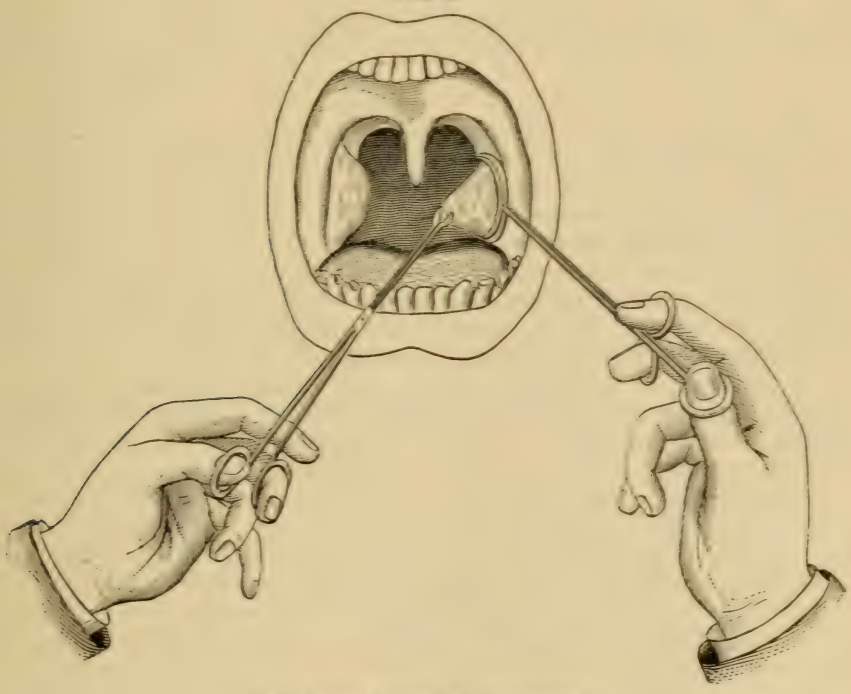
The proper line or point for abscission I believe to be close to the base of the gland, but not so close as to constitute a total extirpation. A stump should be left, but one not much larger than the normal gland, and not of suf-

ficient size to protrude from or widely separate the pillars of the fauces. A total extirpation would seem unnecessarily hazardous on account of difficulty of access to bleeding vessels should hæmorrhage occur, and I cannot think that hæmorrhage is any less prone to occur after total extirpation, as recently stated, than after abscission.

On the other hand, when a considerable portion of the gland is left, only the cortical layer being removed, redevelopment of the growth is common.

Very large and densely fibrous tonsils in older children are best removed

FIG. 6.



The Author's Method of Tonsillotomy.

by the galvano-cautery snare, since they are especially apt to bleed if cut, and are difficult to abscise by a cold wire. In rare instances hæmorrhage even then occurs, either primarily when the wire is overheated, or secondarily on the separation of the slough. The chief objection to the method for general use is the intense inflammation of the fauces which is liable to follow it. This can be, in part, but not wholly, obviated if one is careful not to singe the pillars, which, however, are not so easily avoided in the use of the cautery snare. To this end, Dr. Jonathan Wright has adapted the frame of the Mackenzie tonsillotome to galvano-cautery purposes by substituting for the steel blade a wire mounted on compressed paper and to be connected with a battery.

Consideration of this subject would not be complete without reference to the views of Dr. Harrison Allen of Philadelphia, as advanced in a recent essay before the American Laryngological Association. He believes "that abscission should be restricted to the removal of the superficial or cortical part of the tonsil, and in preference to the treatment by amputation of the whole mass; that after removal of such cortex, should the crypts be closed, he would search

for hidden canals, and when found pass a probe or director through them and freely divide the overlying tissues, incising thus the tonsil in any direction and to any required depth. After this is done the separate coarse lobules can be severally taken up by forceps and removed, care being taken to avoid touching enveloping folds of mucous membrane." It is evident that this would be an impossible method with most young children, because of tediousness, but it may be advantageously utilized with older patients.

The only serious objection to abscission of the tonsils is the rare possibility of troublesome hæmorrhage, which has seemed to a few extreme conservatives to justify avoidance of the operation; but a greater risk is assumed in every phase of life, in travel, and in pursuit of business and pleasure. It is stated that Elsberg made the operation eleven thousand times with but two cases of even alarming hæmorrhage, and Morell Mackenzie, whose experience must have been enormous, only once met with a case in which the bleeding appeared actually to endanger life. Only one authentic case of death of a child from hæmorrhage after tonsillotomy is recorded in modern literature, and it is probable that this case need not have ended fatally but for a deception of the operator relative to the seriousness of the hæmorrhage, by reason of the blood being swallowed by the young child and not expectorated; which caused the adoption of a less vigorous treatment than otherwise would have been used.

When one considers the number of cases, beyond computation, of tonsillotomy in children, and the few reported cases of hæmorrhage, *one must regard it as among the safest of even minor operations.*

The treatment of severe hæmorrhage may consist, first, of a trial of the astringents and styptics. The most popular of these is Mackenzie's mixture of tannic and gallic acids:

℞. Acidi tannici . . . . . ʒvj.
Acidi gallici . . . . . ʒij.
Aquæ . . . . . fʒj.—M.
Sig. Sip and swallow half-teaspoonful quantities at short intervals.

If this fail, it is probable that any simple astringent or vaso-contractor will fail.

Ice, held in the mouth and swallowed, is also an efficient remedy.

Pressure may be successfully applied by grasping the tonsil firmly between the thumb, held within the mouth and enveloped in three or four layers of linen, and the fingers held over the corresponding part of the neck. It must be maintained sometimes for an hour or more.

When the simpler expedients fail, then the bleeding points and surfaces should be accurately located and thoroughly seared by the actual cautery, or the galvano-cautery if at hand. For this purpose one needs several small sponges mounted on long sponge-holders, which, if not at hand, may be substituted by wooden sticks (sponges are much more effective than absorbent cotton); also, a small surgical retractor, like a tracheotomy retractor, in the absence of which a palate hook, or even a bent probe, will serve. An assistant is desirable to hand and clean the sponges.

Under the illumination of a head reflector, the throat should first be well sprayed with a 5 per cent. solution of cocaine, and sponged clear of clotted blood; the bleeding surface can then be exposed to view by holding aside the anterior pillar by means of the retractor, when by rapid sponging the bleeding points can be discerned and then cauterized.

As a substitute for the galvano-cautery one may use a thick wire heated

to redness over a gas-flame. We have used this means successfully with adults, but have never had occasion to apply it with children. If necessary, however, we would endeavor to do so with young children by first administering chloroform and inserting a Whitehead gag, as in operation for cleft palate, placing the patient with the shoulders elevated and the head pendent, so that blood could not gravitate into the trachea.

When the hæmorrhage is comparatively slight exact cauterization of the bleeding points by solid nitrate of silver is effective. Torsion is applicable only when a spurting artery can be seen.

As a last resort, may be mentioned ligation of the external carotid artery, as advised by Delavan, in preference to ligation of the common carotid, which latter might permit hæmorrhage to continue by collateral circulation through the circle of Willis.

VII. Retro-pharyngeal Abscess (Retro-pharyngeal Lymphadenitis).

It is now well established that retro-pharyngeal abscess arises ordinarily not in caries of the cervical vertebræ, but in suppurative inflammation of the lymphatic glands which are imbedded in the posterior pharyngeal wall. In harmony with accepted views of the origin of pus elsewhere, the source of this inflammation must be infection, either from within or without the body, by some one or more of the pathogenic micro-organisms which produce suppuration.

Children are especially prone to inflammations of the lymphatic system. Cervical lymphadenitis is common among them. Frequently it is tuberculous, but often it is not, and usually the acute suppurative variety results from infection by a previously existing tonsillitis. So also with retro-pharyngeal abscess: it is most reasonable to regard it as a secondary infection of the pharyngeal lymphatics from inflammation of exposed and associated muco-lymphoid glands, like the faucial and naso-pharyngeal tonsils. But, whatever the source of infection, whether primary or secondary, the initial stage of retro-pharyngeal abscess is retro-pharyngeal lymphadenitis. Moreover, the lymphadenitis may be of a non-suppurative type, or the disease become arrested in this stage, undergoing resolution without the formation of an abscess.

Bokai reports a case of retro-pharyngeal lymphadenitis in a child eight months old, in which tracheotomy was necessitated by the supervention of alarming symptoms of suffocation. The posterior wall of the pharynx showed diffuse hard swelling without fluctuation, and a deep incision into the mass had yielded no pus. After the tracheotomy resolution was quickly established. This simple lymphadenitis has been but rarely observed in this country, but Bokai, in addition to 400 cases of abscess, mentions 112 cases of simple retro-pharyngeal lymphadenitis as having passed under his observation in the Pester Kinderspital. (See note at end of this chapter.)

In rare instances the source of infection may be rhinitis, communicated through the nasal lymph-channels, or, still more rarely, a suppurative otitis; but, as previously intimated, follicular and suppurative forms of tonsillitis, as well as those forms of tonsillitis and pharyngitis which are symptomatic of the exanthemata, may reasonably be regarded as the most frequent causes of retro-pharyngeal lymphadenitis, which in turn may proceed to the formation of an abscess. Cases which originate in any of these ways are grouped by Bokai under the term "idiopathic;" and of 204 cases analyzed, he placed 189 in this class, in contradistinction to only 7 cases secondary to caries of the vertebræ,

7 cases from burrowing of pus from abscess in the neck, and 1 case of traumatic origin.

Symptoms.—The disease may commence quite insidiously or it may culminate rapidly. Attention is directed to the throat by a deep-seated pain, dysphagia, and, later, by dyspnœa. When located low down in the laryngo-pharynx, a comparatively small abscess may speedily occasion suffocative symptoms. Critical inspection or palpation of the throat will disclose a swelling of the posterior pharyngeal wall, which may be either in the median line or somewhat to one side.

Diagnosis.—The disease is distinguished from œdema of the glottis by inspection, which reveals pharyngeal instead of laryngeal swelling, and from both diphtheritic and spasmodic laryngitis in the same manner; moreover, in both forms of croup the voice is impaired, which is not the case in retro-pharyngeal abscess.

Prognosis.—The affection usually terminates in recovery in from five to fifteen days, the abscess discharging spontaneously in many instances. In a considerable proportion of cases, however, prompt recognition of the disease and evacuation of the pus is necessary to avert a rapidly-fatal issue by suffocation, or, in rarer cases, to prevent burrowing of the pus into the œsophagus, larynx, mediastinum, or pleural cavity.

Treatment.—As soon as pus has formed it should be evacuated by making an incision as near the median line as possible, and then the head of the child should be inclined well forward to prevent the pus from running into the larynx. An ordinary bistoury will suffice for the incision. An exploratory puncture may be made at any time to determine the presence of pus. In Bokai's experience tracheotomy has been but rarely necessary, but it should be promptly performed if puncture of the swelling does not relieve the suffocative symptoms by evacuation of pus.

The syrup of iodide of iron and nutritive tonics are indicated.

VIII. Naso-pharyngeal Adenoid Hypertrophy.

This disease, which is variously known as "adenoid hypertrophy in the naso-pharynx," "adenoid vegetations," and "third tonsil," in multiplicity of cases and gravity of consequences will bear comparison with any other affection of the upper respiratory tract. In the normal state isolated and aggregated muco-lymphoid follicles of the same adenoid structure as those in the pharynx are imbedded throughout in the mucous and submucous tissues of the naso-pharynx. Histologically, each in its simplest form consists of a depression of the mucous membrane lined with its epithelium and enveloped in a stratum of reticular connective tissue, entangled in which are numerous lymphoid cells, lymphoid bodies (closed follicles), and lymphatic and other vessels. Morphologically, they are closely related to the faucial tonsils, which are compound aggregations of the same. At the vault of the pharynx a number of these follicles are grouped together, forming a compound gland analogous to the tonsils, and known as the third tonsil, the pharyngeal tonsil, or the tonsil of Luschka. In the normal state this is not of sufficient size to deserve such appellation, but when hypertrophied, as it frequently is, it bears some resemblance to the faucial tonsil in a state of enlargement. Several sorts of aggregation are distinguishable clinically by rhinoscopic inspection. Of these the more common are: (1) the *fimbriated variety*, in which the growth is composed of several cock's-comb-like masses closely packed together; (2) the *stalactitic form*, in which multiple pear-shaped bodies are pendent, like stalactites, from

the vault of the pharynx, and to which the name "adenoid vegetations" is most truly applicable; (3) the *individuate variety*, in which the mass is made up, in large part, of but a single neoplasm, of firmer consistency, smoother surface, and more or less irregular contour according to size and degree of impaction.

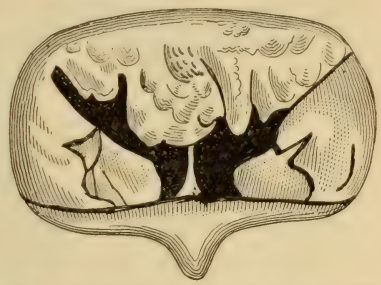
Regarding consistency, this is found to vary in accordance with the amount of fibrous tissue in its composition. In the fimbriated and stalactitic forms the adenoid element predominates, rendering them friable and soft to the touch, while the individuate variety often contains much fibrous tissue, which gives it greater density and tenacity. Between these forms are encountered all degrees of variation both in contour and texture.

Etiology.—Children of syphilitic and tuberculous parents and those otherwise the victims of scrofulosis are predisposed to it, but children in other respects robust are also affected.

The term "lymphatism" has been introduced as a recognition of an underlying dyscrasia which is characterized by hyperplasia of this and other mucolymphoid structures, including the faucial tonsils. Climatic inequalities furnish adequate exciting causes.

Symptoms.—The space of the naso-pharynx is designed to serve as a common area of air-communication between the five openings which enter it. The Eustachian tubes open into it, one on each lateral wall posterior to the nasal choanæ, and upon perfect patency of these openings, together with free nasal respiration, the power of hearing is dependent; for ventilation, with normal air-pressure in the cavity of the middle ear, is essential to correct auditory sense. The adenoid excrescences, when large, are forcibly compressed between the lateral walls of the naso-pharynx or they overlap the tuber of the Eustachian orifice from above, acting in either case as a stopper to one or both openings; or else the vegetations which are crowded in above and behind the Eustachian tubes deform and close the orifice by forcing its upper projecting lip downward to meet the lower border of the rim. Fig. 7, accurately drawn from nature, is a typical representation of an average case, in which the naso-pharynx is seen to be occupied by a fimbriated adenoid mass which occludes, in large part, the posterior nasal choanæ, and so presses downward the upper lip of the tuber of the left Eustachian orifice as to practically close the channel to the middle ear.

Fig. 7.



Naso-pharyngeal Obstruction by Adenoids.

Again, even with lesser hypertrophy, the accompanying catarrhal state is prone to extend by continuity of surface along the Eustachian tube, and to excite exudation or suppurative inflammation of the middle ear. Deafness, therefore, is frequently a deplorable symptom, and one which is liable to become permanent unless speedy relief be afforded.

Into this space open also the posterior nares, the natural respiratory passage being *viâ* the nose and naso-pharynx. Adenoid hypertrophy, therefore, serves as a plug to the posterior nasal openings, and obstructs nasal respiration completely or in part according to the degree of glandular enlargement. From this point we find it a matter of exceeding interest to trace the origin and development of each successive step in the series of deformities consequent upon this condition. The plugging up of the posterior nares necessitates oral breathing, and the constantly open mouth interferes with the normal adaptation of

certain facial muscles, which in turn effects radical changes in the contour of the soft and developing bones of the face, the whole resulting in a physiognomy characterized by a vacant, stupid, almost idiotic expression of countenance, which can be better illustrated by a photograph from nature than described (Fig. 8).

Fig. 8.

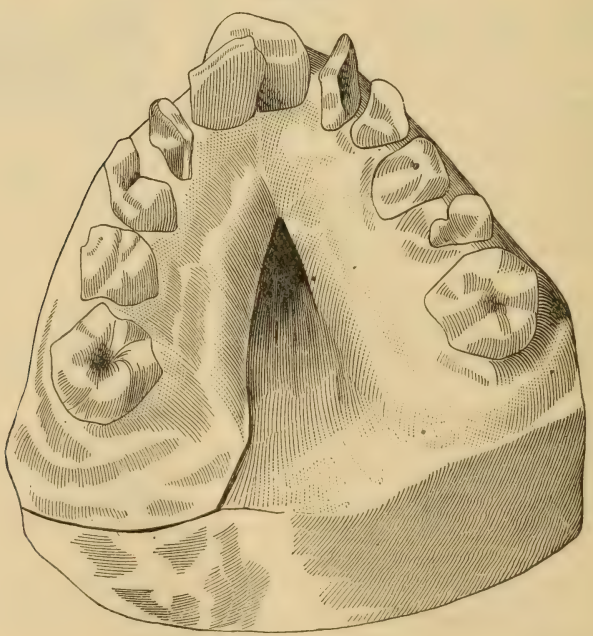


Characteristic Physiognomy of Adenoid Vegetations (from a photograph by the author).

The hanging lower jaw causes the face to appear elongated. The nose is pinched or its alæ distended, while the angles of the mouth and eyes have a drawn appearance.

Moreover, the air-cavities in communication with the nose, as the frontal, maxillary, sphenoidal, and ethmoidal sinuses, which are essential to the proper expansion of their respective bones, cease to develop when the circulation of air through the nose is interfered with, thus altering nature's intent regarding the dimensions of the face and head, and still further deforming the physiognomy. Augmentation of atmospheric pressure upon the buccal surface of the palate process, and the impact of air-currents to and fro during mouth-breathing, together with the diminution of intra-nasal air-pressure incident to nasal obstruction, gradually force upward the centre of the hard palate, and change thus the obtusely rounded Romanesque arch into one of Gothic shape —the pointed or high-arched palate commonly existing in association with long-

Fig. 9.



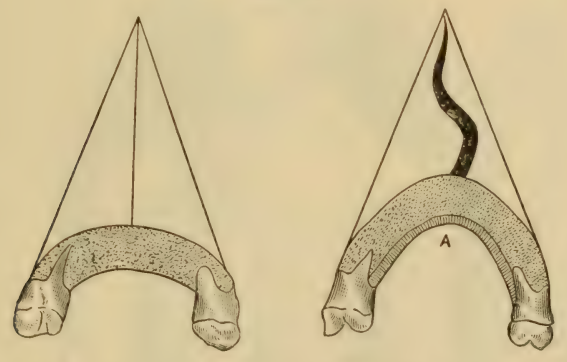
High-arched Palate.

continued and excessive adenoid development during childhood (Fig. 9). Elevation of the palatal arch lessens the traverse diameter of the jaw, and causes it to grow pointed in front—the so-called ∨-shaped indenture; and with the resulting contraction of the alveolar process, the teeth, especially those near the point, are crowded into various grotesque aggregations or are rotated on their axes—a condition depicted in Fig. 9, drawn from a typical case, in which the two central incisors overlap, and the two lateral incisors undergo a quarter rotation and stand at right angles to the alveolar process.

It is proper to state that this relation of mouth-breathing to deformed indentures is questioned by some dental authorities, who attribute the elevation of the palatal arch solely to a perverted production of the permanent teeth. The association between the adenoid hypertrophy as a cause of mouth-breathing and the high-arched palate is, however, so constant that an etiological relationship is most probable.

Next, elevation of the palatal arch must produce contortion within the nose, for the septum, composed of the vomer, the perpendicular plate of the ethmoid bone, and its cartilaginous portion, is unequal in power of resisting compression to the bones by which it is incased. Designed by nature to fill vertically the

FIG. 10.



natural space between the roof of the nose and its floor, the abbreviation of this space by elevation of the palatal arch through the instrumentality of naso-pharyngeal adenoid hypertrophy cannot result otherwise than in forcing the septum to provide for itself by bending and curving laterally in various directions—a condition which is diagrammatically represented in Fig. 10.

FIG. 11.



The septal deflection acts as an additional impediment to nasal respiration and drainage, and becomes a potent factor in the evolution of hypertrophic rhinitis or that form of nasal catarrh characterized by enlargement of the turbinated bodies (Fig. 11).

Headache is also complained of, although a sense of mental obtundity and heaviness is more usual than absolute pain in the head.

Finally, not only, as before said, do these unfortunates *look* stupid, but they really *are* stupid, and exhibit abundant evidence of mental hebetude, with inability to fix the attention, to learn, to memorize, or to reason.

Three varieties of thoracic deformity are observed to accompany obstruc-

tive naso-pharyngeal adenoid hypertrophy, the association of one or other form, in advanced cases, being so constant that a direct causal relationship, although difficult of absolute demonstration, can reasonably be assumed.

For the induction, however, of two of these forms, the "pigeon-breast" deformity and the "barrel-shaped" chest, the intermediation of still another symptom, bronchitis, seems essential; but adenoid hypertrophy is an etiological factor in the production of chronic bronchitis. Especially in neurasthenic individuals it is exquisitely sensitive to reflex-producing impressions, and its irritation may result, reflexly, in spasm of the glottis, cough, asthma, and paretic vaso-motor bronchitis.

The third variety of thoracic deformity, the "flat chest," is due directly to obstruction by the adenoid growth itself, and is an indrawing of the chest-walls, especially a shortening of the antero-posterior diameter, which results from an insufficient air-supply to the lungs. The chest becomes flat and thin (Fig. 12), has a sunken appearance over the lower part of the sternum, perhaps a deep concavity at the ensiform cartilage, with depressed intercostal spaces.

FIG. 12.

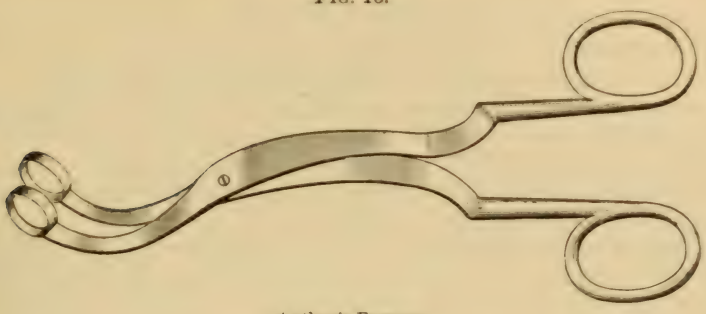


Flat-chest Deformity (Hooper).

Rachitis, so often associated with depraved nutrition, is doubtless the predisposing condition to all of these forms of chest deformity.

Treatment.—For pronounced hypertrophy the only satisfactory method of treatment is removal by surgical means. Many methods by cautery, snare, curette, and forceps, without general anæsthesia, have been described. With older children it makes little difference which of these methods is employed, so that the object is thoroughly accomplished. With young children, however, who will not hold still, most of them are inapplicable, and others border on the barbarous. The young child should be completely anæsthetized by *ether*, and then placed in the *sitting position* on the lap of an assistant, with its head against the left shoulder. The mouth is kept open by a gag similar to those furnished with sets of intubation instruments. Three or four pairs of forceps, either the author's (Fig. 13) or other modification of Löwenberg's instrument, being in readiness, the left index finger is passed behind the velum, followed by forceps held in the other hand; a portion of growth is located, grasped, and

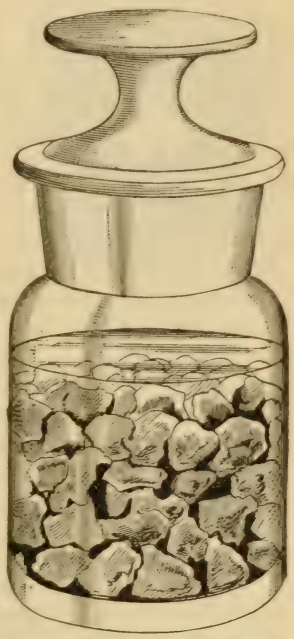
FIG. 13.



Author's Forceps.

removed, when, without withdrawing the guiding finger, quickly a second, third, and even fourth pair of forceps are used, and thus several pieces extracted before active hæmorrhage ensues. Instantly then, the patient is tilted well forward with the head pendent to permit the blood, while flowing actively, to escape by the nose and mouth. In a few seconds the gush is over, the patient can be raised, the remaining blood cotton-swabbed from the pharynx, and the procedure repeated, and still again repeated, until the naso-pharynx is completely cleared. As a final stage remaining shreds are thoroughly scraped by the finger-nail.

FIG. 14.



Representing Adenoid Vegetations removed from one patient.

Little fear need be entertained of blood running down the trachea. That which trickles slowly will course along the œsophagus into the stomach, and at times of rapid flow this danger will be obviated by the method of tilting the child well forward to permit of escape through the nose. Otherwise the blood is liable to gush into the trachea rather than to be swallowed, assertions to the contrary notwithstanding; for the function of deglutition during profound anæsthesia is suspended. Rapid and persistent cotton-swabbing may suffice, but is not so completely effective, and it prevents the reapplication of the anæsthetic during the bleeding interval, so prolonging the operation. The patient should be kept in bed until the following day, and during healing the parts should be cleansed by syringing through the anterior nares with an antiseptic alkaline solution.

Fig. 14 represents the adenoid masses removed from a typical case at a single operation.

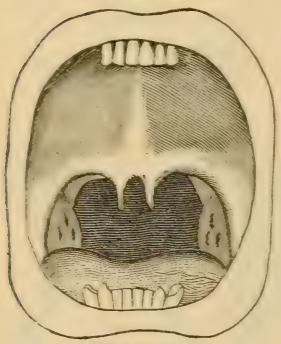
When the adenoids are small and soft, sufficient palliation perhaps, but not an absolute cure, can be effected by thorough and rapid scraping with the cleansed finger-nail, used as a curette, without the administration of ether. Gottstein's knife and Hartmann's curette, when deftly plied, can also be made effective without anæsthesia, but are apt to terrorize both the child and its parents.

Syrup of iodide of iron, internally, tends to correct the underlying dyscrasia —lymphatism.

IX. Cleft Palate.

True cleft palate is a congenital fissure in the roof of the mouth, of variable extent. The so-called acquired cases differ therefrom in presenting an unequal, ragged, or incomplete cleft, such as would be produced by the destructive ulcerations of syphilis. The extent of congenital cleft may vary from the slightest manifestation, that of a bifid uvula, to the grossest form of conjoined cleft palate and hare-lip, in which the fissure involves not only the velum palati and hard palate, but penetrates one or both sides of the alveolar arch and upper lip, with the presence of a separate intermaxillary structure. This article, however, will not embrace the subject of hare-lip except incidentally (Figs. 15, 16, 17).

Fig. 15.



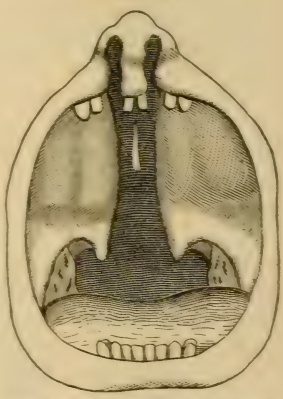
Bifid Uvula.

Fig. 16.



Cleft Palate.

Fig. 17.



Cleft Palate and Hare-lip conjoined.

Etiology and Pathology.—Nature fails to complete her design as originally intended, and the defect doubtless dates from an early period of intra-uterine life. It is assumed that the same causes which produce rickets in children are prone to effect cleft palate. A deficient supply of phosphates in the diet of the mother, or failure on her part to thoroughly assimilate the phosphatic elements, may be regarded as an exciting cause.

Vander Veer states that "several years ago the lions in the Zoological Gardens of London were fed upon flesh containing too large bones for them to break and swallow, as is their custom. The young born while this method of feeding was pursued were observed to have cleft palates, and lived but a short time. The lions were then fed upon small animals, whose bones they could break easily, and the young born afterward had perfectly-formed palates."

Intermarriage and unfortunate "maternal impressions" are also stated to be exciting causes. Whatever may have been the causes of the original inception of the malformation in previous generations, there can be no doubt that heredity now serves as a potent predisposing cause. In my own cases I have nearly always been able to elicit histories of other cases in other branches of the family. Vander Veer, Lawson Tait, and Gurdon Buck emphasize this fact. It will often reappear after skipping one or more generations, or it will diverge into collateral branches.

Symptoms.—The symptoms consist of an inability to nurse or to swallow perfectly, and, later, to talk properly—disabilities, of course, which vary in

accordance with the extent of the cleft. A peculiar nasal intonation of the voice is occasioned, which, if the cleft be an extended one, will first attract attention to the defect in the crying of the infant, and later in life will characterize the speech. In swallowing, fluids regurgitate through the nose.

On inspection in marked cases the parts appear as if there were no soft palate, the side flaps being retracted by muscular tension, leaving a wide, inverted V-shaped opening, through which are visible the posterior and superior walls of the naso-pharynx with their covering of adenoid glandular tissue.

Treatment.—This may be considered in three divisions: prophylaxis, palliative measures, and operative treatment.

Prophylaxis.—Whenever any hereditary tendency to cleft palate, however remote, can be established, it would be a rational precaution to provide in abundance for the mother those articles of diet which are rich in phosphates—*e. g.* oatmeal—and to administer precipitated phosphate of calcium in powder, five to ten grains twice daily. It should be given, however, without the knowledge of the mother concerning the end in view, in order not to excite in her a "mental impression" toward cleft palate. For the same reason, in order to avoid directing the mother's thoughts into this channel, she should not personally be questioned relative to heredity, or the subject be given prominence in any way in conversation with her during the period of gestation.

Palliative Measures.—If the cleft be large, some provision will be necessary to facilitate nursing. A large rubber nipple or one which is large and flat, so as to serve at the same time, while nursing, as a temporary obturator to close the cleft and permit of suction, is generally the best device. Such a nipple can be attached to the glass shield of an ordinary artificial nipple, commonly used to protect the mother's nipple when nursing is painful, thus enabling the child to nurse indirectly from the breast, or it can be used with a nursing-bottle. In this latter case the bottle can be supplied with mother's milk, at least for a time, by the preliminary use of a breast-pump. In extreme cases, especially those which are conjoined with the worst forms of hare-lip, it becomes necessary to feed the child by a spoon or feeding-cup, which is a laborious undertaking, but one likely to result successfully if it be properly carried out. Vander Veer mentions two cases, "son and daughter in one family, where the mother, for nearly two years in each instance, was obliged to give nearly her entire time to their care as regards feeding before they could help themselves."

Later in life, if for any reason the operative treatment be not adopted or if operations should fail, much may be done to lessen the disability by the skilful adaptation of an obturator—a dental plate so constructed as to cover as much as possible of the cleft. A skilful dentist will fashion one to fit accurately and to extend quite far posteriorly, made of firm material, such as hard rubber or gold, furnishing thus a substitute for the hard palate and to a slight degree for the velum palati. But an obturator at best is but a poor substitute for a natural palate; it mitigates, but does not remedy, the defect; and to adopt permanently the use of one in lieu of a radical surgical operation is but to condemn the patient for life to the employment of a more or less troublesome and incomplete appliance.

A radical surgical operation, if it be skilfully managed, will be ultimately successful in a large majority of cases, and its dangers are slight in comparison with the disadvantage of a perpetuation of cleft palate for a lifetime.

Operative Treatment.—On account of the difficulty in phonation the operation for closure of the cleft should always, when possible, be performed

early, before the child has learned to talk in an imperfect manner; otherwise, even though the cleft be closed later, much difficulty is experienced in teaching correct articulation. It should therefore be performed between the ages of one and a half and three years.

The operation is known as staphylorraphy when the cleft involves the soft palate only or extends but little into the hard palate; and osteoplasty when the palate process of the superior maxilla is so deficient as to necessitate the Fergusson procedure of drilling off edges of bone to bring together in the centre.

It is not my purpose to speak of this operation in detail. It is one which has interested the greatest surgeons of the day, and which will be found described at length in all text-books of surgery. But there are certain points essential to obtain a good result—that is, perfect primary union of the two sides—and these salient features of the operation will be described.

It is important that the general condition of the patient be good, and that the season of the year be favorable; that is, preferably, not during the heated term of summer. The bowels should be opened freely the day before the operation by the administration of castor oil the night preceding this. Special care should be taken to avoid vomiting, caused by the anæsthetic, by forbidding any breakfast on the morning of the operation. One can readily understand that the whole success of this long and tedious operation will depend upon securing primary union, and that this preliminary treatment is calculated to insure a condition of health favorable to such union.

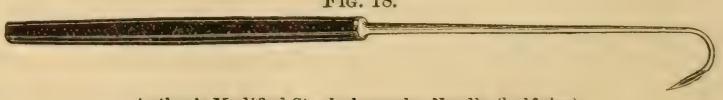
For anæsthesia in operations about the mouth chloroform is often preferred to ether, because its administration can be more interrupted; but children with cleft palate are apt to be generally feeble, so one must consider ether the safer anæsthetic for prolonged use; but one can commence with chloroform, because of its greater rapidity and pleasantness of action, and continue, as soon as unconsciousness is secured, with ether.

As with most other operations on the mouth and throat, the patient should be placed in Rose's position; that is, with the head pendent from the edge of the table, and the shoulders elevated by a small hard pillow, so that blood will gravitate into the naso-pharynx and not into the windpipe. In this position, at times when hæmorrhage is freest, the patient can be rolled upon the abdomen and the blood allowed to flow from the mouth and the nose.

The most suitable gag is Mussey's modification of the Whitehead gag. It has a tongue-depressor attached,—a matter of importance as it is absolutely necessary that the tongue be held depressed at the same time that the mouth is gagged open. The tongue-depressor of the Whitehead gag is attached by a hinge-and-ratchet joint, which easily gets out of order, and detracts from the value of the mechanism. In the Mussey gag the tongue-depressor is a part of the same piece, but by force it can be bent to a different angle if required.

Many and complicated needles have been devised for the purpose, among which may be mentioned Prince's needle as ingenious, but rather complicated. All that is necessary is a curved needle mounted in a handle, as illustrated in Fig. 18. This needle is often kept in the shops, but the curve should be much

FIG. 18.



Author's Modified Staphylorraphy Needle (half size).

more acute than is usually supplied, and the eye of the needle as near as possible to its point. These may seem like small details, but the selection of the

needle is one of the most important points to insure a successful operation, inasmuch as it is sufficiently difficult to place the sutures with a perfect needle, and with a faulty one it may be impossible.

The patient being thoroughly under the influence of the anæsthetic, the first, and absolutely necessary, step is the division of certain muscles. This should be the first step of the operation, and not the last, for the reason that firm and accurate coaptation of the edges can be made only after the perfect relaxation of the muscles thereby produced. Having introduced the gag, one will notice the wide aperture in the roof of the mouth, and that it is seemingly impossible to draw together the two sides of the palate. This is by reason of the constant contraction of the palatal muscles. If one were to draw the two sides together forcibly by means of stitches under the partial relaxation produced by the anæsthetic, they would only be ripped out again at the first effort of the child in crying or coughing or swallowing. Only perfect relaxation of the velum can assure complete primary union of the parts. The muscles to be divided on each side are the tensor palati, the levator palati, the palato-glossus, and one of the palato-pharyngei. The last-named muscles constitute the anterior and posterior pillar of the fauces respectively. The tensor palati arises on each side at the base of the internal pterygoid process, and, descending, its tendon winds around the hamular process, which can be felt by the tongue just to the inner side of the upper third molar tooth, and then spreads through the body of the velum. The levator palati has its fibres distributed just behind the tensor. A puncture, therefore, through the velum, commencing at the point of the hamular process, and following its curve about three millimetres upward, will sever the tendon of the tensor. Then the knife, with its cutting edge directed upward, should have its handle depressed, withdrawn, reintroduced (in the same opening), the cutting edge directed downward and handle elevated, cutting, in this manner, the posterior surface of the velum more widely than the anterior surface, and so severing as many fibres as possible of the levator. Having done this, one will notice how much more easily the two sides can be approximated.

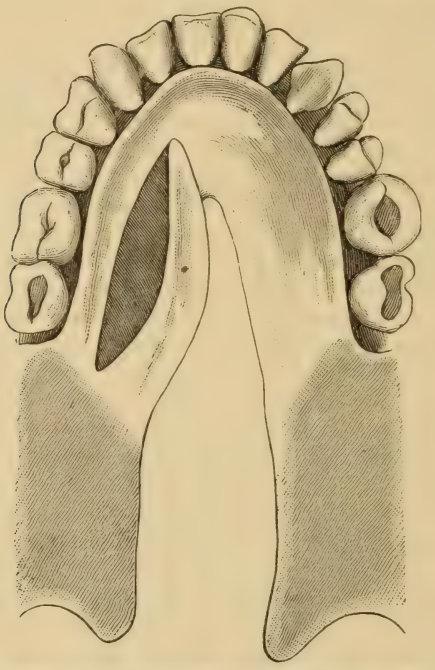
Next raise the velum on each side and snip with scissors the anterior pillar, and, *on one side only*, the posterior pillar, in order to guard against atrophy of the palate by leaving the arterial supply intact on the opposite side.

The hæmorrhage which is caused by these punctures is not likely to be dangerously profuse, although a small artery is severed, but the galvano-cautery point-electrode subsequently introduced would serve to arrest an excessive bleeding.

The edges of the cleft should be thoroughly pared, as merely splitting them does not result in the same satisfactory raw surface, and then provision can be made for closing the cleft in the hard palate. If this part of the fissure be not very extensive, the Warner-Langenbeck method is best. Loosen tissue to slide to the median line by making lateral incisions through the mucous membrane and periosteum, and by incision around and behind the anterior end of the cleft, extending to the bone both on the buccal and nasal surface; then, by means of a periosteal elevator raising the periosteum from the bone from the lateral incisions to the edges of the cleft, which part of the edge must also be well detached from the underlying bone and fascia, and properly freshened wherever it is to join the one of the opposite side (Fig. 19). These two flaps can then be brought together in the median line.

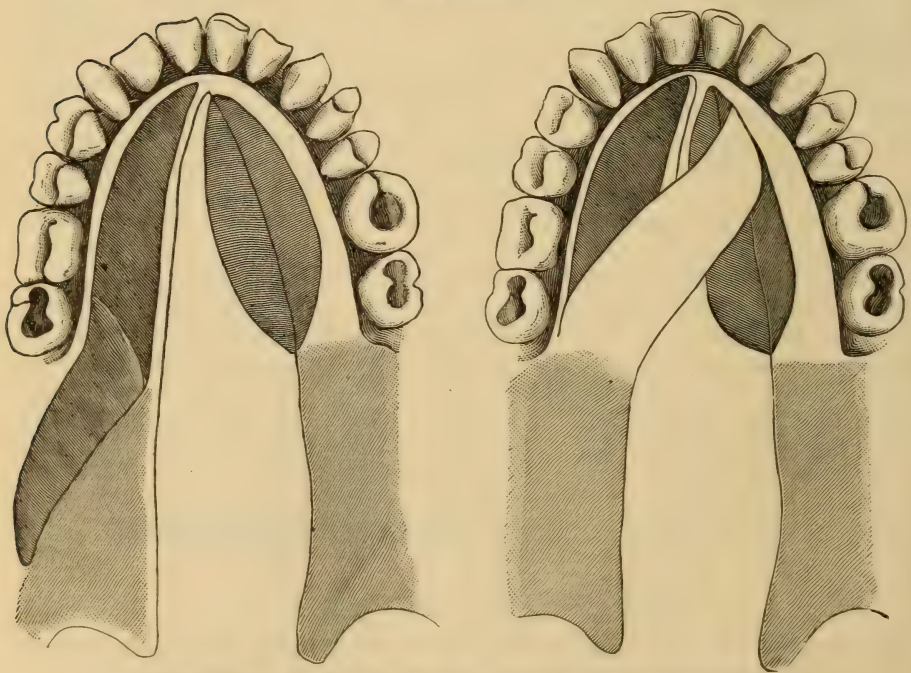
For extensive bony clefts Fergusson advocated the separation, by boring and chiselling, of sufficient of the bony edges to bring together in the centre to close the cleft. This procedure appears unnecessarily formidable, apart from

FIG. 19.



Warner-Langenbeck Method of Closing Small Bony Clefts, flap prepared on one side only.

FIGS. 20 and 21.

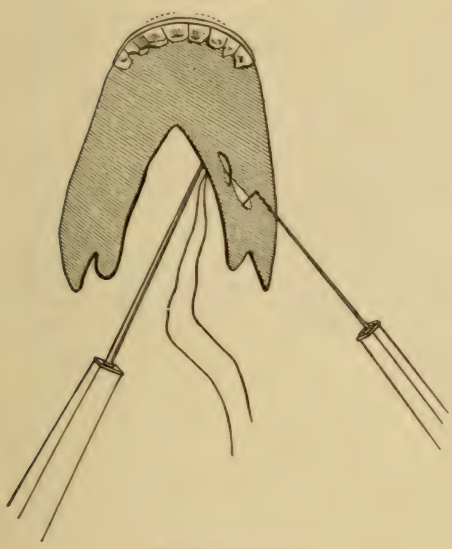


Method of Closing a Wide Cleft of the Hard Palate (after Davies-Colley).

the fact that with very wide cleft—the cases with which the ordinary flap operation is inadequate—the bony edges are likewise too scanty to afford a reasonable prospect of success. For such wide clefts the soft flap method recently proposed by Davies-Colley, of Guy's Hospital, commends itself. Figs. 20 and 21 will convey his idea.

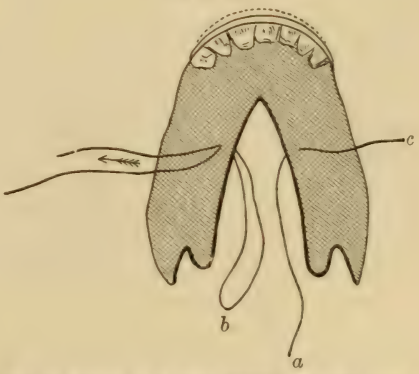
Next, the introduction of the sutures, by far the most difficult part of the operation. I prefer silk sutures, and consider them much superior to silver wire and shot, as they are softer in the mouth, and seemingly do not produce the same amount of irritation and annoyance to the child. Two colors, white and black, should be used, as all the stitches should be passed before tying, and if these colors alternate confusion of the ends need not occur. The well-curved needle, having been threaded, is introduced on one side (the patient being recumbent), from below upward, or what would be, if the patient were upright, from behind forward (Fig. 22). To facilitate passing the needle the flap is held and drawn tense by forceps. The thread is then caught from the eye of the needle by a blunt tenaculum (Fig. 22), one end drawn all the way through, and the needle passed back and drawn off the other end.

FIG. 22.



Passing a Suture.

FIG. 23.



End of suture, *a*, is next passed through loop, *b*, which is used only to draw end *a* through the flap of that side. Ends *a* and *c* are subsequently tied.

This procedure is easier than if the needle were previously passed in the reverse direction, as is usually recommended. Having passed the suture on one side, one must pass a double thread on the opposite side, drawing up in like manner with a tenaculum the two free ends, which leaves the loop below (Fig. 23); the needle is then drawn back as before and disengaged. Then through the loop is passed the lower end of the single suture, and, by means of the double thread, it is pulled through the opposite side. In passing the stitches great care should be taken to engage sufficient tissue, not getting them too near the edge, and also to have them passed as nearly as possible at points opposite each other.

Before tying the sutures special care should be observed to see that the edges of the flaps are clean and free from clotted blood. Then, commencing anteriorly, the sutures are tied first by means of a slip-knot pushed down by the finger,

the suture well tightened, and again tied by an ordinary knot. As the sutures, one after another, are thus tied, see that the edges are not turned in so as to bring mucous-membrane surfaces together instead of freshened edges.

Failure to unite by primary union is probably due to incomplete division of the muscles more frequently than to any other one cause ; but the good health of the child, the careful paring of the edges, and placing of the sutures are also essential points. If, however, complete union should not result at the first operation, we certainly should operate a second or a third time.

It is rare indeed, with ordinary care and skill, that partial union will not be produced at the first trial, and this will encourage both parents and surgeon to persevere to a complete result.

Concerning now the subsequent treatment of the patient: At the completion of the operation, before the patient has revived from the anæsthetic, a hypodermic of morphine should be administered. This to prevent, as far as possible, vomiting and excessive crying—in other words, to maintain quietude of the parts. I consider it best, although all authorities will not be in accord with this opinion, to keep the patient partially under the influence of morphine during the first three days, for the same reason. The stitches may be removed from the sixth to the tenth day. Some of them by the sixth day will have ulcerated out on one or both sides, but this matters not when primary union is secured ; and if primary union is not secured, the stitches will not hold the parts together after the third or fourth day. But as a matter of precaution, to give some strength to the newly-formed union, the stitches may be left until the time stated. To facilitate their removal an anæsthetic should be administered.

[NOTE.—Since going to press the author has observed an instructive case of retro-pharyngeal lymphadenitis in an infant four months of age. The child was convalescing from infectious pseudo-membranous tonsillitis (folliculous) when dyspnœa commenced, and increased for two weeks, when suffocation was imminent. Voice was unimpaired and inspection of the fauces negative, but palpation disclosed a hard tumor projecting from the posterior pharyngeal wall in the median line, low down and pressing upon the opening of the larynx. Three punctures into this tumor failed to evacuate pus. Tracheotomy was immediately performed. Resolution was complete ; at the end of two weeks the tube was withdrawn, and the child recovered.]

GASTRIC CATARRH AND GASTRIC ULCER.

By A. D. BLACKADER, M. D.,

Montreal.

I. Acute Gastric Catarrh.

Acute gastric catarrh, otherwise known as acute gastritis, gastro-adenitis, acute dyspepsia, or gastric fever, is an acute inflammation of the glandular tissue of the stomach interfering with its digestive functions, and generally due to the presence of irritating ingesta. The attack is attended with pain, anorexia, and nausea or vomiting; frequently also by general pyrexia. It is occasionally complicated by reflex nervous symptoms of a more or less serious character. Associated disorder in other portions of the alimentary canal may be met with. While occurring at any age, artificially reared infants and delicate children are especially prone to this disorder.

Etiology.—During infancy the stomach appears to be peculiarly liable to disturbance of its functions. It is the period of its most rapid development, and not only does it increase in size, but it has to assume more varied duties. At the same time, the demands upon it, incident to the very rapid growth of the body at this period of life, are proportionately larger than at a more advanced age. Infants fed at the breast generally escape, but not always. Occasionally errors in diet on the part of the mother, violent disturbance of the nervous system, or the appearance of the catamenia, may produce such changes in maternal milk as to render it less digestible, and thus bring about an attack of acute catarrh in the infant. It is, however, among those who have been artificially fed from the early days of infancy that disturbances of this character most frequently occur. The essentials of artificial feeding in infancy,—a milk, practically sterile, containing the proper amount of albuminoids, fats, and sugars, fed to the infant in proper amounts, at a proper temperature, and at due intervals, so as to permit perfect digestion with a short period of rest for the stomach,—have not yet been generally attained, even in our more intelligent families; while, among the poorer classes, how often does the infant's food fail in every one of these details! During infancy, also, appear the reflex nerve-disturbances generally attributed to dentition. Certainly at this period acute disturbances of the stomach are more frequently met with than either before or after.

By the end of two years the powers of the stomach are more developed; the demands of the system less exorbitant; any irritation accompanying dentition is past; and, under a careful dietary, attacks of acute catarrh should be infrequent. The rich and varied table diet often injudiciously allowed after this age may, however, conduce to an attack.

Generalizing, we may say that any excess in the amount of food, too great variety in its character, the use of such stimulating food as highly-spiced dishes, pickles, or sauces, irregularity in the meal hours, or the unregulated and unlimited eating of fruits, cakes, or sweetmeats, especially between meals, may in

children bring on an attack of acute indigestion. Food or drink, too hot or too cold, quickly taken, may also occasionally be an exciting cause.

Closely associated with errors in the dietary as an etiological factor is the imperfect mastication so often given to food. Children require to be taught to masticate, and their teeth from the time of their first appearance should claim the careful attention of the attendants.

There is not, however, in all children an equal susceptibility to disturbance. Some appear to have particularly vigorous stomachs which tolerate much abuse, while it is only with the greatest care that attacks can be averted in others. In some a predisposition to weak digestion is distinctly hereditary. Anæmic children are peculiarly prone to attacks. The close association between rickets and disorders of digestion has long been recognized. The scrofulous and rheumatic diatheses are also predisposing factors. Unsanitary conditions of life markedly impair the digestive powers, and thus favor an acute disturbance: especially is this true of want of exercise in the open air.

The acute ailments and specific fevers of childhood frequently leave the mucous membrane of the alimentary canal in a weakened condition, from which it takes time and a very careful dietary to thoroughly recover. Of this class of disease Ewald says: "Although the gastric symptoms are relegated to the background by other manifestations, yet in those cases with dyspeptic disturbances, in which we are enabled to examine the organ soon after death, we will find the anatomical changes of acute gastritis."

In some children the sudden checking of the cutaneous circulation, by chill from imprudent exposure, may occasionally interfere with the process of digestion and bring about an attack. Eustace Smith thinks this a very frequent cause of trouble. In our more severe climate children are more perfectly clothed in flannel than in England, but in children with weak stomachs I have frequently noticed an attack of gastric catarrh brought on by getting the feet damp. Unless due care be exercised, one attack may predispose to others.

Pathology.—Our knowledge of the minute changes in the mucous membrane in acute gastric catarrh has, until lately, been very limited; so much so, that some writers have questioned the propriety of admitting this among the list of actual diseases. In his recent work Ewald protests against the use of the word "catarrh" as creating an erroneous conception. "The structure," he says, "of the gastric mucosa, better designated the glandular layer, *tunica glandularis*, is such that it is out of the question to call it a mucous membrane in the ordinary meaning of the term. . . . . It is simply a peculiar feature of the inner layer that the protoplasm of the epithelium of the excretory ducts possesses in a remarkable degree the property of being converted into mucus. . . . . Dr. Beaumont's investigations on his patient, St. Martin, showed that every catarrh, even the mildest, was accompanied by a disturbance of the secretion of gastric juice: consequently by an affection of the glands themselves. The inflammation is thus not catarrhal, but parenchymatous and interstitial. It has nothing in common with a catarrh except the "flow," the secretion of a more or less abundant, but always alkaline, transudate into the cavity of the stomach. Misled by the term "catarrh," we are too prone to underestimate the importance of these processes, particularly when they are chronic, and by thinking, for example, of a chronic pharyngeal catarrh, we lose all proper standards of comparison."

Macroscopically, the mucous membrane in acute catarrh appears swollen and reddened. In severe cases slight hæmorrhages, or even small erosions, may occur; the submucosa may be œdematous. Microscopically, there appears an infiltration of the interstitial tissue with leucocytes; the differentiation between

the parietal and the principal cells can no longer be made out, while all the cells may alike be seen to have become granular and cloudy, and in part separated from the *membrana propria* of the glands. The mucous cells are especially abundant in the pyloric region, and extend down deeply into the ducts of the glands.

Symptoms.—Cases of acute gastric catarrh have been divided into two classes, the *febrile* and the *afebrile*, according as they are, or are not, accompanied by pyrexia. The division is a convenient one. The febrile are much the more severe. The afebrile run a short, mild course, and are as a rule unaccompanied by serious symptoms.

The onset of an attack is generally sudden. Within an hour or two after the error in diet the child shows signs of being unwell. If an infant, after a short sleep it awakes crying and apparently in pain. Its thighs are flexed on the abdomen. It moves restlessly from side to side, and whines piteously or cries bitterly. The temperature will be found more or less elevated, 102° to 104°, the pulse and respiration quickened, the tongue furred, the abdomen distended, and pressure on it evidently increases the child's distress. The bowels at this time may, or may not, show signs of disturbed action. Vomiting generally occurs early, with some temporary relief. After this the infant, if allowed, may eagerly take the breast or its food again, only to reject it, curdled and sour-smelling, after a short interval. If the ejecta be carefully examined, there will be found a marked deficiency of hydrochloric acid, and in its place the presence of lactic and butyric acids. Vomiting may recur several times; at the last, watery, sour-smelling mucus, perhaps more or less bile-stained, being ejected. There is now complete anorexia. The infant is restless and feverish, if not actually crying with pain, and its sleep is much broken and disturbed. Under proper treatment the attack is generally of short duration, and in twenty-four or forty-eight hours a few loose movements carry away any of the offending material that has escaped into the bowel; the fever subsides; the infant again sleeps quietly; but for a few days it is less eager for its food, which it is inclined to take more slowly and in smaller quantity.

In older children the attack manifests itself by a feeling of listlessness, with more or less drowsiness. The child will give up its play and prefer to lie down. Uneasy pain in the epigastrium is soon complained of, with a feeling of nausea and headache. If the child fall asleep, it is a very disturbed sleep, from which it frequently awakes in a fright, complaining of bad dreams. Dark circles may now be noticed under the eyes: the face is generally pallid unless the fever runs high. In that case a peculiar pallor about the upper lip and the alæ nasi is very distinctive of irritation of the stomach. The tongue is coated heavily toward the base, but the tip and the edges are red: the skin is dry; the pulse is quickened: the temperature may be high—103° to 104°—but if so it reaches its height early; the abdomen is distended, pressure over the epigastrium increasing the uneasiness; and the breath is generally heavy or sour-smelling. The secretion of saliva is increased, so that during sleep it may dribble on the pillow. Vomiting may occur, but not so generally as in infants. When it does, there is usually much retching, and toward the close biliary matters, with watery mucus, are ejected with much straining. The bowels are constipated and the urine scanty and high-colored, with an abundant sediment of lithates. The headache is generally frontal, although sometimes temporal. In some cases an associated pharyngitis may be noticed; in others a few herpetic vesicles appear on the lips. In mild cases the attack subsides in a day or two, but in the more severe forms the fever may persist for four or five days, leaving the child in an exhausted state, from which, however, under careful

dietary, it generally recovers rapidly. Occasionally an attack of acute gastric catarrh is followed in a few days by catarrhal jaundice. The inflammation has probably extended down the duodenum, blocking the common bile-duct. Such cases are usually of short duration.

Although, in general, an attack of acute gastric catarrh may give us little anxiety, at times we have associated reflex symptoms of a very alarming character. The convulsive seizures of infancy, dependent so frequently upon gastric or intestinal irritation, are familiar to all and require prompt treatment. The danger of cerebral hæmorrhage during such an attack should always be borne in mind.

In older children more alarming, because more unusual, symptoms of reflex irritation are occasionally met with. In some instances localized or diffuse clonic muscular movements have their origin in gastric irritation. Symptoms closely resembling those of meningitis have been reported by Seibert. Fraenkel relates the case of a child four years old who shortly after eating a large amount of table food lost the power of movement and sensation on the right side. Complete recovery followed on the next day. Henoch records a case of complete aphasia in a child which passed away an hour later after the vomiting of some undigested fruit. Such cases, however, are rare, and should always receive the most careful attention on the part of the physician, lest, instead of being reflex, they arise from a distinct and all-important lesion.

Diagnosis.—In most instances, with a distinct history of some error in diet, no serious difficulty will be experienced in arriving at a guarded conclusion. The sudden onset, the tenderness over the epigastrium, the relief afforded by vomiting, and the rapid subsidence of the symptoms will in a day or two enable us to assure the parents that no more serious trouble need be apprehended. In cases attended with fever, however, it is always wise to speak more or less guardedly at the first. The onset of scarlet fever should always be excluded. In this disease we have as an early symptom a definite amount of congestion of the fauces, followed frequently by some enlargement of the glands at the angle of the jaw. The irregular erythema, sometimes appearing for a few hours in disorders of the stomach, should be distinguished from the scarlatinal eruption with its more regular development and longer duration. In doubtful cases, for such will arise, isolation for twenty-four or forty-eight hours will solve the problem. Tonsillitis and diphtheria may, with care, be easily excluded. An attack of acute catarrh may closely resemble the onset of pneumonia. J. Lewis Smith relates a case in which the high temperature and expiratory moan simulated a pulmonary inflammation, but was promptly relieved by the expulsion of some orange-pulp. In cases such as these careful attention must be paid to the pulse, the respiration, and the temperature. In typhoid fever the rise is more gradual; we frequently meet with an initial bronchitis, the prodromata are more marked, and some enlargement of the spleen may be made out. In acute gastric catarrh the onset is more sudden, and the distention of the abdomen more marked, than is general in typhoid fever at an early stage, while tenderness is noted in the epigastrium, not in the iliac region, and the temperature falls after a few days. In delicate children the possibility of tuberculosis must always give us anxiety. We have no absolute symptoms by which we can exclude this disease. A slow pulse may occasionally be met with in gastric disorder from irritation of the vagus. The vomiting of meningitis is, in general, indistinguishable in its character from the vomiting of mere gastric irritation, and the condition of the tongue is no certain guide. Under these circumstances a careful watch for localizing symptoms will be required, and a very guarded opinion must be given.

Prognosis.—The prognosis of acute gastric catarrh must be regarded as very favorable. Only in delicate infants, whose hold on life is extremely frail, will the disturbance of nutrition or the gastric irritation threaten immediate serious results. Such an attack may be the beginning, however, of a gastro-enteritis, which may prove fatal. Convulsive seizures are always serious. Relapses are common in artificially-fed infants and in older children unless due care be exercised.

Treatment.—In acute gastric catarrh the first important indication for treatment would appear to be the removal of the offending material in the stomach. Nature in many cases effects this spontaneously by the induction of vomiting. Should we see the case early, before vomiting has taken place, we may favor it by the administration of ipecacuanha, either in the form of a powder, or of the wine or syrup. If some hours have elapsed, however, a large portion of the offending stomach-contents may have escaped through the pylorus, and a gentle but prompt purgative is then called for. The following are suitable prescriptions under the circumstances:

℞. Hydrarg. chloridi mitis . . . . . gr. ij–iv.
Sodii bicarbonatis . . . . . gr. xij.—M.
In pulv. iv. divid.
Sig. One every three hours until a free evacuation of the bowels is secured (for a child of three years).

Or, ℞. Hydrarg. cum creta . . . . . gr. vj.
Sodii bicarbonatis . . . . . gr. viij.
Pulv. rhei . . . . . gr. viij.—M.
In pulv. ii. divid.
Sig. One to be given immediately (for a child of three years).

Or, ℞. Sodii et potassii tartratis . . . . . gr. xxx.
Sodii bicarbonatis . . . . . gr. iij.—M.
In pulv. vj. divid.
Sig. One to be given every hour in a wineglassful of hot water until a free evacuation is secured (for a child of three years).

In those cases where vomiting is troublesome and persistent minute doses of calomel, or of calomel and soda, may be given dry on the tongue. My own preference is for the triturate of a tenth of a grain, or of the tenth of a grain of calomel with a grain of soda, to be given hourly until eight or ten doses have been taken. This generally checks vomiting and secures a free evacuation of the bowels within twelve or twenty-four hours. It probably serves also to check to some extent the development of bacteria in the stomach. Should pain in the epigastrium be complained of, a warm poultice of linseed-meal, either pure or with a proportion of mustard, applied over this region, will be a source of much comfort. After the first acute symptoms have passed off, a mixture containing sodium bicarbonate, with a minute dose of nux vomica, will distinctly favor a return to healthy secretion:

℞. Sodii bicarbonatis . . . . . gr. xlviij.
Tr. nucis vomicæ . . . . . ♏vj.
Aquæ carui, ... ad f℥iij.—M.
Sig. One dessertspoonful to be given four times daily (for a child of three years).

As the case progresses and the inflammatory action subsides, the amount of the nux vomica may be increased.

The dietetic treatment is even more important than the medicinal. After the stomach is emptied it should have complete rest for some hours. Water in small quantities or small pieces of ice should be all that is allowed until the inflammatory action has sufficiently subsided to permit the secretion of gastric juice. Any attempt to give the child food before this will only increase the existing hyperæmia. In general, after about twelve hours of abstinence, milk diluted with either Vichy or lime-water, may be allowed in small quantities at a time. Should it disagree, a weak broth with barley- or rice-water may be tried. The recourse to solid food must be gradual. Starchy food, which is principally digested in the small intestine, may first be given, while stronger nitrogenous food is withheld for a few days longer.

Should nervous symptoms, such as sudden twitchings or startings, make their appearance, great quiet should be maintained in the sick-room, which should be moderately darkened. At the same time an enema, containing bromide of potassium or chloral, or both, in a little starch- or gum-water, may be given to relieve the nervous irritability, and, if possible, to ward off any convulsive seizure.

As long as the pulse is quickened or the temperature elevated the child should be kept in bed. Afterward over-fatigue should be avoided, as tending to a relapse.

When the gastric irritation has quite subsided, the tongue become clean, and the appetite has to some extent returned, the administration of some ferruginous tonic, with a daily drive in the open air, will generally prove of distinct value.

II. Chronic Gastric Catarrh.

This disease, also called chronic glandular gastritis, or chronic vomiting, is a chronic inflammatory condition of the glandular tissue of the stomach, giving rise to a diminution in both the quantity and the quality of the true glandular secretion (hydrochloric acid and pepsinogen), but attended with the secretion, sometimes in large quantities, of an alkaline mucus which possesses no digestive powers. As a result of this condition we meet with, in time, an enfeeblement of the muscular coat of the stomach leading to the undue retention of food. Chronic gastric catarrh is undoubtedly the condition most frequently encountered in the chronic digestive disorders of childhood. Only very seldom at this period of life can such disorders be referred to a distinct neurosis.

Etiology.—The causes leading to the condition of chronic gastric catarrh in childhood are closely allied to those already mentioned as inducing an acute catarrh. The continued irritation of the gastric mucous membrane by the ingestion of large, imperfectly masticated and insalivated morsels of food; by the habitual use of food, indigestible or improperly cooked, such as hot bread or cakes, pastry, and fried dishes; or by the habit of eating sweetmeats at all hours of the day, may occasion this condition, either directly or indirectly, by producing acrid fermentation in the contents of the stomach. Another source of irritation is the continued contamination of the food by offensive discharges from ulcerations in the nose, throat, or mouth; from decaying teeth; and from the muco-purulent discharges, often very considerable in amount, from adenoid growths. Repeated attacks of an acute or subacute form are very liable to lead to this condition, especially in children with lowered vitality living under imperfect sanitary conditions. The presence of anæmia, rachitis, or scrofula

may be regarded as distinctly predisposing; also prolonged convalescence from an acute inflammatory or specific fever.

Any engorgement of the gastric veins due to valvular heart disease or to chronic inflammatory disorder in the liver and lungs will, of course, distinctly predispose to this condition.

Pathology.—The conditions in chronic catarrhal gastritis are but an extension of those referred to under the heading of Acute Gastric Catarrh. The whole organ is usually enlarged. The mucous membrane, usually thickened, is of a pale-gray or slate-gray color, with insular deeply injected areas, and is covered with a closely adherent layer of mucus. In places, especially in the vicinity of the pylorus, the hypertrophied mucous membrane may form small papillary projections, the so-called *état mamelonné*. In more advanced stages this condition may give rise to distinct polypoid outgrowths. The minute anatomy, says Dr. Ewald, is that of a parenchymatous and interstitial inflammation, most noticeable in the pyloric region. The gland-cells may be found partly destroyed, partly granular, and partly shrivelled up. The differentiation between the principal and parietal cells is impossible. In many places the ducts have lost their regular form and show an atypical ramification. There is an abundant small-celled infiltration, most marked near the surface of the mucosa. The superficial layer of the epithelium of the mucosa is loosened, and can be separated in adherent shreds. The mucoid transformation of the cells of the tubules is a prominent feature, and may be observed to extend down to the base of the glands. Whether this degeneration may to any extent retrograde, or whether it is permanent, Dr. Ewald has not been able to decide.

As the disease advances changes in nutrition produce a progressive fatty degeneration of the cells, with finally complete atrophy of the mucous membrane. To this condition Dr. Ewald proposes to give the name of *anadenia of the stomach*. This atrophic process may advance in two ways: (1) by progressive destruction of the glandular parenchyma, so that finally nothing is left but a layer of small round cells, in which appear isolated remnants of the former parenchyma; (2) by a marked activity of the interstitial connective tissue, leading to hypertrophic proliferation, with much thickening of the walls, but with great contraction, so that the capacity of such a stomach becomes very limited.

In either form it is a severe irreparable process, which specially involves the glandular layer of the stomach, and which is characterized by a complete disappearance of the secretory parenchyma.

Symptoms.—The symptoms at first are those of impaired digestion. The appetite is lessened, except at occasional intervals, when it may appear increased. Ill-defined gastric distress and colicky pains, with distention of the abdomen, indicate the presence of fermentation. Nervous symptoms, such as headache, listlessness, irritable temper, and disturbed sleep, owing in great measure to reflex irritation, become manifest. General nutrition sooner or later begins to show signs of impairment. The child looks pallid, dark circles appear under the eyes, the muscular system is badly nourished, the pulse is wanting in tone, and slight exertion produces signs of fatigue. The indications of digestive disorder now become more prominent: the appetite fails at the regular meal-hours, but during the intervals there may be cravings for unsuitable food. The breath, especially in the early morning, is heavy-smelling; eructations occur during the day; pain, referred to the epigastrium, is frequently complained of: nausea, recognized by sudden pallor of the countenance, recurs occasionally, but vomiting in older children is infrequent. In

infants vomiting is often a most pronounced feature; hence the title, "chronic vomiting," often given to the disease. Constipation is generally pronounced, and is very difficult to relieve. The motions consist of hard rounded masses, of offensive smell and variable color, passed with much straining, and generally associated with an increased amount of mucus. Occasionally an evening rise in temperature may be observed, exciting suspicions of typhoid fever or tuberculosis. In the more severe cases, after the disorder has run a prolonged course, and the failure in general nutrition has become very marked, "the patient either literally pines away like a lamp the oil of which has not been replenished," or falls an easy victim to some intercurrent disease.

Such may be said to be a general picture of this disease. Its course, always very prolonged, is perhaps more irregular than that of most chronic affections. The stimulus of a season at the seaside, or in bracing mountain-air, may for a time make an improvement in such children, especially in the early stages of the disease, but unless we can secure the necessary watchfulness over the dietary and general hygiene, a fresh exacerbation is easily induced, with renewal of all the unfavorable symptoms.

In infancy symptoms of indigestion occasionally appear shortly after birth. Frequently the fault in such cases lies in the character of the nutriment supplied to the infant; but sometimes a feeble power of digestion appears to be inherited. Should disturbances of the digestive functions persist, the infant becomes restless, fretful, and colicky. Attacks of vomiting occur frequently; sometimes shortly after the food is taken, on some slight movement, the greater portion of the meal will be rejected, curdled and sour-smelling. At other times vomiting takes place some hours after the meal, and consists of watery mucus and lumps of hard curd or other undigested food. The appetite is variable; at times the breast or the bottle may be refused absolutely, and again food may be taken eagerly at first, but is shortly pushed aside with evident signs of distress. The face is pale, and, instead of the normal expression of placid content, it frequently puts on a pained look. The tongue is generally furred, but in infancy this is not so reliable a symptom as in older children. Sleep is fitful, much disturbed, and for short intervals only. Nutrition distinctly fails. Instead of the normal increase of from four to eight or ten ounces per week, the infant may scarcely hold its own or may even lose weight. The skin, along with the other tissues, suffers from lack of nutrition, the subcutaneous fat is absorbed, and the superficial veins show distinctly through its more delicate structure; the muscles are small and flabby; the extremities are with difficulty kept warm; the fontanelles, if open, will be found depressed; and the coronal suture may be prominent, owing to depression of the frontal bones. Constipation is a frequent symptom, but occasional attacks of diarrhœa occur, with the passage of undigested food and some mucus. Various forms of skin rashes frequently make their appearance, such as erythema, urticaria, and lichen. Vomiting in such infants, especially if there be much failure in general nutrition, is always a symptom requiring much attention. In my own experience it has almost invariably yielded to patient and careful treatment, but it quickly reduces the strength, and hydrocephaloid symptoms may supervene. Parasitic stomatitis is apt to prove a troublesome and, in a few cases, a serious, complication. If symptoms of indigestion persist and wasting becomes extreme, all our measures seem to fail, and the infant sinks into the condition known as simple atrophy.

A few of the symptoms met with in older children require more extended notice. Pain and uneasiness, referred to the epigastric region, is a very common complaint. In general, the distress becomes more pronounced shortly after taking food, but occasionally it seems to be more felt when the stomach is

empty. In all cases distinct tenderness is elicited by pressure on the epigastrium. The tongue is usually large and flabby, with heavy yellowish fur toward the base. The tip is red, and its papillæ reddened and prominent. Occasionally we meet with a comparatively clean tongue, or one marked by crescentic and wandering rashes. Too much importance must not be placed upon its appearance. The appetite is whimsical, variable, or sometimes altogether wanting. In some it is satisfied after a few mouthfuls, and afterwards requires much coaxing. Although a feeling of nausea is not an infrequent symptom, vomiting seldom takes place except on the occurrence of an acute exacerbation.

The sleep of such children is generally much disturbed. They toss about from side to side, dream, and talk in their sleep. Occasionally they may awake suddenly in great terror, and remain for some few minutes screaming wildly under the influence of fright, unable to recognize their attendants. Somnambulism in children is generally due to this same cause.

The amount of interference with nutrition that may take place is variable. Some appear to grow fairly well, though they remain pale; their frame is well developed, but the muscles are deficient in tone. In others nutrition is markedly defective. They are small for their age, their muscular tissue is poorly developed, and their pulse small, weak, and occasionally intermitting. Such children are liable to suffer from neuroses. Headaches, chiefly frontal, are frequently complained of; the temper is uncertain, and generally very irritable. Local muscular twitchings of choreic character are not infrequent. Syncopal attacks, closely resembling those of *petit mal*, are sometimes met with. Disturbances affecting the heart's action, or the respiration, have been reported.

The nutrition of the skin in such children is always impaired. Their skin is never clear, but is generally sallow in appearance.

A reflex irritation, referred to the nostrils or the anus, manifested by a constant picking of the nose or scratching at the seat, is very common and is extremely troublesome. A "stomach cough," generally due to an accompanying pharyngeal catarrh, is a not infrequent symptom. As a rule, it is most troublesome during the hours of sleep.

The course of chronic gastric catarrh in children varies much. After it has persisted for some time there is always a marked tendency to distention of the stomach, with impaired muscular action. This, if not checked, may go on to the production of actual dilatation, especially in those cases where the abdominal parietes are much relaxed. In some the large secretion of mucus becomes a prominent symptom, the disease extends to the lower portion of the alimentary canal, and general nutrition becomes still more rapidly lowered. (See article on "Mucous Disease.") In the severer forms of atrophy of the glandular tissue of the stomach the clinical picture may be that of a pernicious anæmia.

Diagnosis.—In the diagnosis of chronic gastric catarrh there should rarely be much difficulty. The long history, the epigastric tenderness, the disturbed digestion, and impaired nutrition, after the exclusion of organic trouble in the lungs, heart, or kidneys, will indicate clearly the character of the trouble with which we have to deal. If possible, however, an exact determination should be made by examination of the stomach-contents one hour after a test breakfast, which in older children should consist of bread and milk. The examination may be easily managed in infants by passing a soft rubber stomach-tube and withdrawing some of the contents. In older children this is more difficult, but may sometimes be managed. Advantage may be taken of any ejecta, or artificial means may be used to produce emesis. By this measure three forms

of chronic gastritis may be distinguished: 1. Simple gastritis, in which, after the test breakfast, hydrochloric acid is found in diminished quantity, while lactic and butyric acids are usually present. 2. Mucous gastritis, which differs from simple gastritis chiefly by the presence of a large amount of mucus. 3. Atrophic gastritis, in which the secretion of hydrochloric acid and pepsin is almost entirely absent.

In some cases of impaired digestion in infants it is necessary to exclude the presence of hereditary syphilis and tuberculosis. In the former possibility a decision should be arrived at without having recourse to medicines, as in simple gastric disorder a course of antisyphilitic remedies may do harm (Pepper). In older children the presence of pyrexia, with the symptoms of chronic gastric catarrh, should always suggest the possibility of typhoid fever. The same considerations should influence us in forming a diagnosis in the case of chronic, as in that of acute gastric catarrh.

Popular opinion generally refers many of the symptoms of chronic gastritis to the presence of intestinal worms. In suitable cases it may be desirable to give a few doses of mild vermifuge to exclude their presence.

Prognosis.—The prognosis of chronic gastric catarrh in childhood, if placed under careful dietetic and hygienic treatment before the atrophic changes have proceeded too far, may be regarded as good. In infancy there is always danger of extension of the trouble to other portions of the alimentary canal. This is especially the case during the summer months. The continued interference with nutrition renders children more prone to the development of some intercurrent disease.

"While the dyspepsias of children are not of themselves often fatal, they are serious on account of the vulnerability of system they induce. They are prone to recur. They are apt to interfere with normal development, and to entail subsequent debility of digestion, of nerve, or of the entire nutrition" (Pepper).

Treatment.—The treatment of chronic gastric catarrh is in many instances one of the most unsatisfactory that we can undertake. The disease is apt to run a prolonged course and to have many relapses. The families in which we meet our more severe cases are frequently those who can only with much difficulty be impressed with the importance of strict attention to the details of treatment, and when we finally succeed in convincing the parents of the necessity of our rules, we find that the children refuse to be controlled.

Our first step in each case must be to investigate carefully all the factors, exciting and predisposing, tending to impair the functions of the stomach. The character of food taken by the child must receive our most careful attention, and, making due allowance for the idiosyncrasies of digestion so frequently met with among children, a systematically arranged dietary for the week should be drawn up, and rigidly adhered to, in each case. Instructions should be given that the attendant insist on proper mastication of the food. Nervous children especially are very apt to bolt it. Should the teeth be so defective as seriously to interfere with mastication, all food requiring it should be minced before giving it to the child. The amount also should be carefully regulated. I am convinced that many children accustomed to a richly-spread table have a tendency to overfeed themselves. Dinner, the heaviest meal of the day, should be taken about noon. The evening meal should be a light one. The general hygiene of the child will also demand the most careful attention if our efforts are to be successful. The child should live a quiet, regular life; it should retire early to bed, and its sleeping apartment should be cool and airy. The morning bath should be of a stimulating character.

For these children I prefer the bath recommended by Wiederhofer. The child on getting out of bed first receives a general rub down with a somewhat rough towel. It then steps into the bath, which contains warm water to the depth of three or four inches. It is afterward sponged down quickly with cool salt water, of which half a gallon or more is to be emptied over the chest and shoulders. When the sponging is finished, the child is then at once wrapped in a large towel and is briskly dried and dressed.

Children suffering from chronic gastric disorder are easily fatigued, and under the influence of excitement may readily over-tire themselves. This is to be avoided. At the same time, regular moderate exercise in the open air is to be insisted on.

There are several indications that should be considered in our administration of medicine:

1. The deficiency of gastric juice, which is generally met with in these children, may sometimes with advantage be supplied by the administration shortly after meals of hydrochloric acid with pepsin. In those cases where the tongue is coated with a white creamy fur an alkali, such as sodium bicarbonate, given shortly before the meal, appears to act as a sedative to the mucous membrane, while at the same time it stimulates to more active secretion the cells elaborating hydrochloric acid.

2. In almost all cases there is a deficient tone in the muscular coat of the stomach which calls for the administration of one of the vegetable bitters. My own preference is for nux vomica, in smaller or larger doses as the case may require. Columbo, gentian, or quassia may also be employed, either in the form of infusion or tincture.

3. In many cases, owing to the large amount of mucus, fermentation either in the stomach or small bowel becomes a prominent feature, and the distention thus induced may, if allowed to persist, lead to a more or less paretic condition of their muscular walls. To relieve this aromatics may be added with advantage to our remedies, but some reliance may also be placed on antiseptics. Salol under these circumstances has, I think, given me very satisfactory results.

Should diarrhœa supervene, a combination of bismuth and salol will prove very serviceable. To relieve the colicky pains often complained of by these children some anodyne may occasionally have to be employed. I have also used with much benefit large enemata of warm water, as recommended by Ashby.

In infants, and sometimes in older children, vomiting becomes occasionally a troublesome feature, persisting in spite of treatment. Absolutely no food, under these circumstances, should be given by the mouth, all extraneous sources of irritation should be removed, and sedative enemata, containing small doses of either opium or bromide with chloral hydrate, may be given twice daily to subdue the nervous erethism. In these cases *lavage* of the stomach has sometimes proved a successful therapeutic measure. Dr. Booker, after a large experience in the Thomas-Wilson Sanitarium, says: "I believe stomach-washing is of undoubted advantage in the treatment of the digestive disorders of infancy. It has proved with me the quickest and most effective means for the relief of the vomiting, which I found generally relieved after the first washing; in only one case was it found necessary to stop milk food. The contra-indications to the use of the measure are heart disease and serious bronchitis or other pulmonary trouble. When the tube continues to excite vomiting and strong resistance, it is doubtful if advantage follows its use. A feeble condition of the infant does not necessarily contra-indicate the operation." In

older children lavage is rendered extremely difficult, owing to their determined resistance. Possibly results less efficient, but somewhat similar, may be obtained by the administration of warm alkaline drinks on an empty stomach. A combination of the potassio-tartrate of soda with a small amount of the bicarbonate, dissolved in hot water, may be given early every morning, or equal parts of Vichy and hot water may be taken once or twice daily. Sufficient time should be allowed for this to pass out of the stomach before food is taken.

In cases associated with constipation a determined effort should be made to secure a regular movement of the bowels once a day, with the least possible amount of irritation to the gastric mucous membrane. Some preparation of cascara may be given regularly at bed-time in doses sufficient to secure a daily motion of fair consistence. The action of the medicine should be favored by daily gentle massage of the large bowel, and by regularity in the time of soliciting a movement.

In children suffering from chronic gastric disorder any sudden chill of the surface should be prevented by the habitual use of a flannel binder over the abdomen. The extremities should be efficiently covered; the feet and ankles especially should be always dry and warm. Although ferruginous tonics, if symptoms of any acute exacerbation are present, may disagree, they may be given to many of these children with advantageous results.

III. Gastric Ulcer.

Gastric ulcer is a lesion affecting the mucous membrane of the stomach, characterized by the formation of an ulcer of varying size and depth, and of uncertain position on the gastric wall. The disease in childhood may be indicated by symptoms similar to those met with in the adult—namely, epigastric tenderness, pain increased by the ingestion of food, and hæmatemesis. Occasionally the symptoms are very obscure, and a diagnosis is impossible until an autopsy reveals the cause of death. It is an exceedingly rare affection in childhood, and very few cases have been reported.

Etiology.—Gastric ulcer in children is generally associated with some constitutional disorder, such as tuberculosis, struma, and anæmia. Pneumonia and purpura hæmorrhagica are also mentioned as predisposing. Colgan reports a case in a child of two years and a half, due apparently to chronic gastric catarrh. Tuberculous ulcers are often multiple.

Symptoms.—According to Descroizelles, anorexia develops early and is steadily progressive. Vomiting may come on, but sometimes nausea only is complained of. Eructations and pain are frequently present, and the ingestion of food is generally followed by an exacerbation of the suffering. In some cases the symptoms are by no means distinctive. In one case reported the physical signs simulated those of pericarditis; in another, those of pneumothorax. In the case related by Colgan a well-nourished child had been in fair health up to the morning of the attack, when she complained of feeling unwell. Toward the evening she was seized with convulsions. When seen by Dr. Colgan her temperature was 106°; the pulse 150, rather full and tense; and the breathing stertorous. The convulsions were general, and there had been involuntary evacuations from both bladder and rectum. The convulsions were temporarily controlled, and consciousness, which had been lost from the beginning of the attack, was beginning to return, when a second attack occurred and terminated fatally. At the autopsy a perforating ulcer was found, with consequent peritonitis. The gastric mucous membrane was in a chronic catarrhal condition.

Gastric ulcer, dependent upon emboli from thrombosis in the umbilical vein, is said to be a frequent cause of hæmorrhage in the new-born.

Prognosis is very unfavorable.

Treatment.—The treatment, too, is generally unsatisfactory. If a diagnosis be made, the child should be confined to bed, and, if possible, it should for some days be fed only by the rectum with artificially digested food. Afterwards, a gradual return should be made to milk or bland starchy food, given in small quantities and frequently repeated. Of drugs, nitrate of silver in small repeated doses is probably one of the most satisfactory. Small doses of opium should be given to relieve pain. Gentle, soothing applications may be made over the epigastrium. If vomiting occur, bismuth is indicated.

Gastro-malacia.

This term is applied to the softened, and sometimes ulcerated, condition of the stomach occasionally found after death in children. It is dependent upon the action of the gastric juice, which may happen to be present in the stomach at the time of death, upon the walls of the stomach itself, now dead and unprotected. Goodhart believes that an action may commence just prior to death, owing to a very defective circulation insufficiently protecting the tissues. Even if such be the case, it is the result of ebbing life, not a disease causing death, and as such it calls for no further remark.

MUCOUS DISEASE.

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The fact that many different names and many etiological factors have been advanced to designate the train of symptoms and explain the pathology of the disease under consideration, serves to show that as yet there is not an entire consensus of opinion as to the proper classification of this condition.

Space forbids a complete recapitulation of the host of synonyms under which this disease appears in medical writings. We cite but a few: Chronic gastro-intestinal catarrh; Intestinal desquamative catarrh; Mucous disease; Chronic muco-colitis; Chronic croup of the intestines; Chronic follicular inflammation of the intestinal mucous membrane; Chronic pseudo-membranous gastro-enteritis; Mucous or Gelatinous diarrhœa; Mucous casts.

The term membranous enteritis has recently become somewhat restricted to a particular form of intestinal disorder characterized by irregularly recurring paroxysms of abdominal pain, unaccompanied by fever and relieved by the passage of membranous shreds or tubes, which for the most part are composed of mucin.

The present chapter will be restricted to a consideration of mucous disease as described by Eustace Smith of London, who defines it as an increased secretion of mucus from the whole internal surface of the alimentary canal: it is a mucous flux which interferes mechanically with digestion and absorption of the food, and by its influence in impeding general nutrition often excites suspicion of the existence of tubercle. This disease, unlike its analogue, membranous enteritis, is a very frequent condition among children, in whom it is most usually met with between the ages of three and twelve years.

Etiology.—The infectious diseases, particularly measles and scarlatina, but above all pertussis, may be followed by mucous disease—indeed Smith considers that pertussis, of all others, is the one to which this derangement can commonly be traced. It must not be forgotten that the mucous membrane of the alimentary canal in the child is naturally very active, and that the healthy stool in the young infant contains a large proportion of mucus; so that we can readily understand that if the child be habitually fed on indigestible food, thus presenting a constant source of intestinal irritation, the normal mucus may appear in abnormal amounts.

We must also remember that the stool of the healthy infant contains many bacteria and micrococci. Osler says that the most important are the bacterium lactis aerogenes and the bacterium coli commune.

In diarrhœal conditions the number is greatly increased. Booker has isolated forty varieties, and his conclusions are, that in the diarrhœa of infants not one specific kind, but many different kinds, of bacteria are concerned, and that their action is manifest more in the alteration of the food and intestinal

contents and in the production of injurious products, than in a direct irritation upon the intestinal wall. So that from the authority of this careful observer, together with that of Jeffries and Baginsky, we may conclude that mucous disease is not bacterial in origin and does not arise from the presence of a specific micro-organism.

We, however, must state that Cornil considers that the peculiarities in all forms of membranous enteritis, mucous disease, and the like are not owing to different anatomical lesions, but to the difference in the nature of the micro-organisms: he considers that all forms are due to special micro-organisms introduced with the food.

Heredity does not merit consideration among the etiological factors, nor does climate, as the disease is seen in all countries and in all climes: it is perhaps more frequent in England than elsewhere, although this may be due to the fact that English observers have more carefully recorded their observations. It is usually seen in association with other diseases of the intestinal tract: an antecedent dyspepsia or a diarrhœa alternating with constipation is frequently noted before mucous disease becomes firmly established.

Day agrees with Meigs and Pepper that whether diarrhœa be caused by improper food, summer heat, dentition, or epidemic influences, the complaint, if it becomes chronic, is apt to terminate in mucous disease. It has been observed in children to follow typhoid fever, enteralgia, hæmorrhoids, and intestinal tuberculosis.

We ourselves have always accepted the statement of DaCosta that the disease was a manifestation of disordered nervous supply, which may be either general or local, and that the nerves presiding over nutrition and secretion are primarily at fault.

Wales is of the opinion that the primary seat of the disorder is in the ganglionic nerves of the intestines.

Certain it is that all of our cases presented marked evidences of deranged nervous action, and we agree with Goodhart, who considers the class of diseases that are the subject of this article under the title of "abdominal neuroses," and further states that he "is persuaded that although they may seem to be caused by temporary conditions—such as errors in diet—these varying pains and aches are often but the expression of a constitutional build. They are an evidence of nervous instability, and they are found in nervous children or in nervous families." In this observer's experience the children who are the subjects of mucous disease are the offspring of those whose nervous systems are feeble or diseased, or who are closely related to, or have themselves been, the subjects of fits, insanity, hysteria, neuralgia, rheumatism, or gout; or if not, have in themselves given other evidence of unstable nerves in the convulsions of infancy, passionateness, morbid timidity, chorea, or rheumatism.

Louis Starr, the American editor of Goodhart's book, favors the views of Eustace Smith.

Symptoms.—In the more chronic cases of mucous disease there is an almost constant sequence of symptoms. A coated, anæmic, flabby, and fissured tongue is usually observed, with aphthous ulcers of the mouth and tonsillar derangements.

Smith considers the appearance of the tongue to be absolutely characteristic: it appears to him as if brushed over with a solution of gum; this slimy look may be generally limited to a small spot in the centre of the dorsum. In my experience the whole tongue is more apt to be clean, stripped of epithelium, glazed or glossy. See accompanying Plate (XV).

All the stools do not contain mucus, but its passage may be paroxysmal, or

there may be an accumulation of mucus, and the discharges for several days may be made up almost entirely of this substance, or a great mass may be passed at a single stool; constipation may exist or this condition may alternate with diarrhœa. The patient may have only one mucous stool a day, or, as I have seen them, twelve to fifteen in twenty-four hours; after an attack of this kind the discharges are usually free from mucus for several days, or even for weeks, and the child apparently improves for a time, but only to suffer another exacerbation in a shorter or longer period. A simple enema or a mild aperient usually brings away large quantities of clear mucus or mucus stained by fæces. These children rarely pass a normal fæcal evacuation: the fæces are apt to be soft, mushy, light-colored, and mixed with or coated over by mucus. The stools occasionally contain worms.

Some cases present certain premonitory symptoms before one of these large discharges of mucus occurs, as chilliness, blueness of the nails, tingling or pain at the finger-tips, dyspeptic symptoms, and a sense of uneasiness usually referred to the umbilical region. Smith has also observed that a most frequent seat of pain is over the left hypochondrium, and explains this by calling attention to the fact that at this point the colon makes a very abrupt turn, and the angle thus formed presents a site for the accumulation of flatus.

During an acute attack the former sense of uneasiness may become true pain; in some instances it is most severe; tenderness may extend over the entire abdomen, or it may be localized and developed only by firm pressure. Nausea or vomiting, in my experience, does not often occur, although it is mentioned by some writers.

The breath is usually most unpleasant, heavy and fetid; the tonsils are apt to be diseased, and no doubt contribute their share to this unpleasant odor.

The temperature is rarely above normal except perhaps at the height of a painful paroxysm; indeed an abnormal temperature would lead one to suspect some other and more serious condition, as phthisis. The surface temperature to the touch seems to be below normal, although the thermometer will probably not so record it.

The nervous system is early affected, and presents many evidences of derangement; hysteria in some of its many forms may exist, and night-terror with its peculiar concomitants, nocturnal incontinence of urine, somnambulism or the insomnia of gastro-intestinal origin, irregular muscular tremors, paresis, hysterical tetanus, neuralgia, hyperæsthesia, anæsthesia, convulsions, syncope, and stammering, have all been observed. Tinnitus aurium, transient defects in vision, as squinting, a disordered sense of taste, hæmorrhoids, prolapse of the rectum, and anal fissure have also been noted. The child's nature seems to have undergone a radical change: he is irritable and exacting; he suffers from mental depression, faulty memory, and hypochondriasis. In the older child melancholia may be noted.

Furuncles or carbuncles may arise, and sore mouth or herpes of the genitals are not unusual.

The appetite is at first increased, then becomes capricious, and finally almost complete anorexia exists; food produces distress by flatulent distention of the bowels, and it is only by the exercise of good tact that the little patient can be induced to eat at all. This, however, is not true of all cases: some children maintain their appetite throughout the disease, but, notwithstanding the enormous quantity of food consumed, the emaciation is extreme. The skin may have the characteristic hue of anæmia or the sallow tint of jaundice; it may be harsh, rough, and scaly. The urine is apt to be acid and to contain an excess of urates. I have not observed that the lymphatic glands in the neck are pecu-

PLATE XV.



THE TONGUE IN MUCOUS DISEASE (Louis Starr).

liarly liable to become enlarged on the slightest irritation, as stated by Smith, who also adds that they do not, however, necessarily suppurate or remain permanently swollen; the enlargement, after persisting for a variable time, may disappear completely.

It must be remembered that the little patient who is the subject of mucous disease does not present a regular sequence of symptoms, so that it is a difficult matter to present a didactic picture of the derangement; the symptoms are as erratic as the child itself. As Goodhart aptly remarks, such children are essentially angular in their moral nature and are an "odd lot." In this connection attention may be called to a paper by Ayres (*Med. News*, vol. lix., No. 1, 1891, p. 1) on chronic gastro-intestinal catarrh in relation to the etiology of some cases of insanity.

Microscopic Appearance of Matters Passed.—They are very similar to the masses passed in cases of membranous enteritis, and are made up of opaque white solid masses, moulded or flattened, and small flocculent pieces of semi-translucent membrane. The tubes, branching membranes, casts, and fine network membranes are not seen in mucous disease. The description I have elsewhere given of membranous enteritis (in Keating's Cyclopædia, vol. iii. p. 166) also applies to the mucous masses voided in chronic gastro-intestinal catarrh.

Under a low-power objective the masses are seen to be due to the formation of mucous and epithelial matter (the cells having undergone fatty degeneration), and granular débris. H. B. Hare states that these matters are similar in chemical reaction to pharyngeal mucus, that they may possibly contain a trace of albumin, but no fibrin. Their surface may be seen to be composed of opaque and translucent parts; the former appear as rounded ridges marking off the latter into regularly arranged hexagonal or polygonal crypts.

Clark has observed that the product of diseased action on mucous membranes occurs in three varieties: first, clear, jellylike, and imperfectly membranous; second, yellowish, semi-opaque, flaky, and usually membranous; third, yellowish-white, dense, opaque, distinctly membranous, tough, and rather adherent to the subjacent surface.

Morbid Anatomy.—The morbid anatomy of the disease seems to be a thickening of the intestinal mucous membrane; there may be evidences of ulceration or enlargement of the glandular follicles of the colon or small intestine, the sigmoid flexure, and the descending colon, together with the lower part of the ileum.

Diagnosis.—As I have elsewhere remarked, if mistakes arise in the diagnosis of the affection, they are in all probability due to the carelessness of the observer rather than to any obscurity in the manifestations of the usual clinical phenonema of the disease.

The mucous masses may resemble and have been mistaken for ascaris lumbricoides; indeed, the parasite may be present in the discharges, as it finds in the mucus-loaded intestine a peculiarly acceptable habitat. The white, shining, detached pieces have been mistaken for segments of the various tape-worms, tænia mediocanellata, tænia solium, and bothriocephalus latus.

The lienteric discharges of dysentery have also been erroneously considered as illustrations of this disease; in scarlatina and tubercular disease mucous deposits are sometimes passed per anum.

The disease, however, of all others, with which we are apt to confound mucous disease is general or pulmonary tuberculosis: here it is that a carefully recorded series of temperature records is invaluable. In tuberculosis we find a continued elevation of temperature, while in mucous disease the temperature is

usually normal; at all events, it is only elevated during the height of a paroxysm, remaining high for two or three days and returning quickly to the normal.

Smith makes the statement that in some cases the temperature rises and remains elevated, perhaps permanently, although the symptoms in other respects correspond to those of mucous disease. I have never met such cases. He considers that these subjects are peculiarly prone to pneumonia, and that the deposit, only partially absorbed, undergoes cheesy transformation and forms the so-called pneumonic phthisis. Under these conditions I must confess that the differential diagnosis between mucous disease, pneumonic phthisis, and tuberculosis would indeed be a difficult problem to solve.

Prognosis.—Most cases run a prolonged and tedious course, with many recurrent attacks and exacerbations, extending sometimes into adult life. Absolute recovery rarely occurs.

Treatment.—The child that is the subject of mucous disease must submit to a constant supervision of its daily life. Its diet, regimen, and personal hygiene are of vital importance. The little patient must have a daily bath, first with castile soap and warm water, then a general sponging with alcohol, followed by an inunction of olive oil. In this way the peculiarly harsh, dry, and scaly skin can be restored to its normal function as one of the excreting organs of the body.

The diet always merits the most painstaking care; indeed, without a correct and suitable diet all other methods of treatment will inevitably fail. All sources of irritation are to be removed; easily-digested or even pre-digested food should be supplied, and the medical attendant should satisfy himself that undigested particles of food are not irritating the alimentary canal.

The following diet-table is taken from Eustace Smith (fifth edition, 1888), and is applicable to a child of seven years of age and upward:

Breakfast, 8 A. M. Three-quarters of a pint of fresh milk alkalinized by twenty drops of the saccharated solution of lime; a thin slice of well-toasted bread; fresh butter; a fresh egg lightly boiled or poached.

Dinner, noon. A mutton chop without fat, broiled; well-boiled cauliflower or French beans, according to season; a thin slice of well-toasted bread; half to one wineglassful of sound sherry, diluted with twice its bulk of water.

Tea, 4 P. M. Same as breakfast.

Supper, 7 P. M. A breakfast-cupful of beef-tea (a pound to the pint); a thin slice of dry toast.

Or we can adopt a diet-table that I suggested in a lecture before the University Training-School for Nurses, which is that of the North-eastern Hospital for Children, London:

	Milk Diet.	Fish Diet.	Full Diet.
Breakfast, 7 A. M. .	Milk, ½ pint; bread, 2 ounces, with butter.	Milk or cocoa, ½ pint; bread, 2½ ounces, with butter.	Milk or cocoa, ½ pint; bread, 2½ ounces, with butter.
Dinner, 12 M. . . .	Milk, ½ pint; rice or other milk pudding.	Fish, boiled, 2½ ounces; potatoes, mashed, 3 ounces; bread, 1 ounce; milk pudding.	Roast, boiled, or minced mutton, or roast or minced beef, 2½ ounces: mashed potatoes, 4 ounces, to alternate with green vegetables; bread, 1 ounce; milk pudding.
Tea, 3.30 P. M. . . .	Milk, ½ pint; bread, 2 ounces, with butter.	Milk, ½ pint; bread, 2½ ounces, with treacle or butter.	Bread, 2½ ounces, with butter, treacle, or dripping; milk, ¼ pint.
Supper, 6 P. M. . .	Biscuit (cracker) or slice of bread and butter.	Bread, 2 ounces, with butter, or cracker.	Bread, 2 ounces, with butter, or cracker.

In the more serious forms Jacobi adheres to a very strict diet. He says: "No

raw milk, no boiled milk, no milk at all in any mixture, in bad cases." In the very worst cases total abstinence is recommended by this writer for from one to six hours; afterward the following combination is allowed: Five ounces of barley-water, one to two drachms of brandy or whiskey, the white of one egg, salt, and cane-sugar; a teaspoonful every five or fifteen minutes, according to age or case.

Jacobi in his terse way remarks: "That never are the common sense and tact of the intelligent practitioner more thoroughly taxed; no printed rule ever supplies or substitutes brains."

If the appetite be capricious, these strict dietetic rules cannot of course be adhered to; we must then endeavor to supply such a variety as will tempt the appetite and check the tissue waste. If the stools show a mass of milk curds, milk must be diluted, predigested, or altogether prohibited.

The various preparations of predigested food may now be resorted to: milk, milk-gruel, milk-punch, effervescing milk-punch, beef-tea, and oysters may all be prepared in this manner. Raw beef-juice, beef-tea, consommé, chicken, mutton, or veal broth are preparations upon which we may often place absolute dependence. Farinacea as a rule must be excluded, although we occasionally have to allow a little rice pudding, tapioca, or flour-ball by way of a variety. It is somewhat odd to note in this connection that Burnet in his valuable little book on Foods and Dietaries recommends the farinaceous substances as a suitable diet in mucous diarrhœa.

Alcohol is not by any means contraindicated, and may be administered as wine-whey or a combination of milk, egg and brandy. English writers advise well-diluted light sherry or light claret.

Among medicinal agents many and varied plans of treatment have been suggested. Recently much attention has been paid to intestinal antisepsis, but it is interesting to note that so recent and reliable a writer as Osler, in his *Practice of Medicine*, considers that "we are still without a reliable intestinal antiseptic. Neither naphthaline, salol, resorcin, salicylates, nor mercury meets the indications."

This has not been our clinical experience, nor indeed has it been that of the general practitioner.

Dujardin-Beaumetz recommends the following formula as a satisfactory intestinal antiseptic:

℞. Salol . . . . . .
Bismuthi salicylatis . . . . . .
Sodii bicarbonatis . . . . . *āā* gr. cl.
Sig. Divide in capsul. No. xxx. One capsule before breakfast and before dinner.

Droixhe considers salol as a remedy easily administered and without toxic action, and ranks it among the approved intestinal antiseptics.

Carreras suggests resorcin in the following formula:

℞. Resorcin . . . . . gr. ij–vij.
Syr. aurantii . . . . . f℥j.
Aq. citronellæ . . . . . q. s. ad f℥iv.—M.
Sig. Three teaspoonfuls every three hours.

The same author suggests that when the child is fed exclusively upon

milk the dejecta may be very acid; in this case some such mixture should be given as—

℞. Bismuth. phosphat. aut subnitrat. . . . . gr. xxx.
Sodii bicarbonat. . . . . gr. xv.
Pepsinæ . . . . . gr. vij.
Pulv. ipecac. comp. . . . . gr. j–iv.—M.
Divide in chart. No. iij.
Sig. One every hour or two.

Creolin has been recommended in the following combination:

℞. Creolin . . . . . ♏viij.
Sacchari . . . . . gr. lxxv.—M.
Divide in chart. No. x.
Sig. One every two or three hours.

Or,

℞. Creolin . . . . . gtt. i–ij.
Syrupi . . . . . f℥j.
Aq. menthæ piperit. . . . . f℥ij.—M.
Sig. Teaspoonful every two hours.

Schwinz also endorses creolin.

Naphthaline may be given to young children in doses of ten centigrammes every two hours. Pure naphthaline never causes accidents even when used in large doses. It may be given per rectum in a mucilaginous mixture which will hold it in suspension but not dissolve it. Bouchard thinks naphthol is superior in its action to naphthaline.

Constipation may exist sometimes to a stubborn degree: mild saline laxatives may be exhibited, or a simple enema may occasionally be administered, and will usually cause the expulsion of large masses of mucus.

Irrigation of the stomach is generally agreed upon by all writers to be a most efficacious method of dealing with the more chronic examples of the disease. Osler speaks of it in the warmest terms in cases of the most obstinate gastro-intestinal catarrh in children. This method must be combined with the irrigation of the large bowel. The last-quoted authority states that a pint will thoroughly irrigate the colon of a child aged six months, and a quart that of a child of two years. When the temperature is high, ice-cold water may be used for this purpose.

Booker has had a large experience in stomach-washing. His apparatus is the one proposed by Epstein. A soft Nélaton's catheter, No. 8, 9, or 10, is attached by a short glass tube to a common rubber tube two feet long, with a 2 ounce (62 grammes) glass funnel fitted into the distal end; a pitcher containing a half-gallon (2 litres) of tepid water is placed in a convenient position.

It is only within a short time that the plan of washing out the stomach, which was inaugurated by Kussmaul for diseases of that organ in adults, has been applied to children. The difficulties connected with its application are few, and the dangers, even for the youngest and weakest infants, easily avoided. Kussmaul's apparatus for irrigating the stomach consists merely of a Nélaton's catheter, a long rubber tube, and a funnel, and this simple apparatus will accomplish all that is necessary. Escherich's apparatus has greater advantages, however, and is preferred. The time required for irrigation of the stomach is

usually four or five minutes, from half a litre to a litre and a half of water being usually required before the return flow is clear. If there is gastric or intestinal catarrh, a few drops of a 6 per cent. solution of benzoate of sodium and a few drops of tincture of opium may be given hourly after each irrigation. Irrigation is contraindicated only in very feeble children and when collapse is impending. The same apparatus is also used for intestinal irrigation, excepting that a larger and stiffer catheter, with much larger lateral opening, is employed. It may be introduced, if necessary, to a distance of 27 centimetres, and the entire large intestine washed out.

Ehring's experience in this method of treatment in 850 cases has been rapid cure in 68.7 per cent. of cases, moderate success in 14.58, failure or death in 16.73. This writer further considers that the indications for this treatment exist in all cases of intestinal catarrh. Riemschneider reports the results obtained in 140 cases by this method, and is favorably impressed with the results obtained by washing out the stomach with Escherich's apparatus; he follows the irrigation of plain water by an irrigation of a 3 per cent. solution of benzoate of sodium. Of these cases a quickly favorable result was obtained in 89, a slowly favorable one in 31; in 20 the result was fatal.

Seibert in treating 1404 cases of gastro-intestinal catarrh used stomach-washing in 521 cases, and states that the results were most gratifying both in stomach- and bowel-washing.[1]

Von Ziemssen recommends cutaneous electrization of the stomach with very large electrodes, for half an hour before meals. This treatment is supplemented by faradizing for a short time with the wire brush the skin of the abdomen, cheek, and back. Massage of the stomach and intestines is also of value, although of less importance than electricity.

Electrization of the intestines is accomplished with large electrodes, one occupying the entire abdominal surface, the other the entire dorsal surface; and the electricity must be of increased intensity, owing to the great size of the electrodes. The subjective results of this treatment are increased appetite and loss of abnormal abdominal sensations.

When the excretion of mucus is excessive the alkalies will assist materially in arresting its secretion: we usually select the bicarbonate of sodium; this may be combined with twenty-drop doses of tincture of myrrh, as suggested by Smith, or the powdered myrrh which Maxson speaks so highly of, given in divided doses of from 9 to 12 grains a day, either in capsules or with mucilage of acacia, glycerin, and liquorice. Podophyllin and aloes are much lauded

[1] Dr. W. Soltau Fenwick cites the dangers of washing out the stomach: 1. Convulsions and tetany. Probably because, in a case predisposed to convulsive seizures by the chronic absorption of certain morbid products from the dilated stomach, the irritation of a gastric tube may constitute an efficient exciting cause. 2. Syncope and sudden death. Any sudden alteration in the gastric pressure can, in certain cases, bring about a reflex condition of shock. 3. Perforation. The using of a gastric catheter for the purpose of investigating the chemical contents of the stomach in cases of acute gastric ulcer is a useless and mischievous procedure. 4. Hæmorrhage. Danger may arise from a too rapid evacuation of the contents of a dilated stomach. 5. Injury to the œsophagus or to the walls of the stomach. 6. Poisoning. From the use of antiseptics through the tube. Cases are cited illustrating each division. He concludes that the stomach is washed out for all sorts of symptoms, some of which are manifestly not to be benefited by this procedure. And in cases in which it fails to do good it is likely to be productive of harm in removing products of digestion whose manufacture has caused the stomach a considerable amount of labor. The indiscriminate use of this method in every case of disordered digestion will prove to be a curse rather than a benefit, and will eventually throw discredit upon the whole method of treatment.

Booker says stomach-washing is contraindicated in children affected with heart disease, serious bronchitis, or pulmonary trouble. If the tube continues to excite vomiting and strong resistance, it is doubtful if advantage follows its use.

by the English writers; our preference has been for some of the milder laxatives. We have obtained good results from the following combination:

℞. Pulv. rhei . . . . . 3j.
Magnesii carb. . . . . 3iij.
Pulv. zingiber. . . . . 3ss.
Elixir simp. . . . . q. s. ad f℥viij.—M.
S. Teaspoonful night and morning for child of five years.

Some cases do well upon the acids, nitric, hydrochloric, or nitro-muriatic. Strychnine, ipecacuanha, and gentian in pill is sometimes a happy combination.

Belladonna, Dover's powder, quinine, subnitrate and subcarbonate of bismuth have all been suggested. Quinine may be given in two-grain suppositories combined with a sixth of a grain of opium, as suggested by J. C. Wilson.

When the gastro-intestinal tract is in condition to receive it, iron becomes a valuable adjunct: we select either the tincture of the chloride combined with nux vomica and dilute phosphoric acid, or the dried sulphate of iron with aromatic syrup of rhubarb. Arsenic, copaiba, bromide of potassium, turpentine, cod-liver oil, oxide or nitrate of silver by mouth or by high injection into the bowel, chloride of ammonium, sulphate of zinc, bichloride of mercury, chlorate of potassium, oxide of zinc, blisters, nux vomica, ergot, are among the drugs recommended by various writers. Gold has been suggested as follows:

℞. Auri . . . . . 20 grammes.
Mellis . . . . . 125 grammes.—M.
Sig. One coffeespoonful in the morning and two in the afternoon.

Antiquedad states that hydrotherapy, sulphate of quinine, chlorate of potassium, and revulsion are the means which will be found most efficient in the treatment of intestinal catarrh in children.

It is quite useless to order cod-liver oil while the alimentary canal is covered with mucus; when we have modified the mucous discharges, oil then becomes a valuable drug. These children, however, cannot assimilate large doses.

Much is to be gained by a residence in a suitable climate. We can formulate no rules, however, as to the locality to be chosen; each case is a rule unto itself. My practice has been to leave the matter of selection of a climate to a great extent to the patients themselves, with, however, a promise that the locality must be such as to permit of an almost constant out-door life, the greatest number of clear sunny days, and the least variability of thermometric range. It must also be understood that the patient will spend several years at the place of selection.

DIARRHŒAL DISEASES.

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There are many difficulties in the way of a satisfactory classification of the diarrhœal affections of infancy. The gravest symptoms in the most speedily fatal cases are often accompanied by the most superficial lesions; while, on the other hand, symptoms so mild that no anxiety is awakened may result from marked and extensive pathological changes. Cases which are apparently identical clinically often reveal diverse lesions. It is therefore apparent that the pathological alterations do not form a suitable basis of classification. The variations from the normal condition found after death are dependent more upon the length of the continuance of the diarrhœa than upon the primary exciting causes. The majority of cases of infantile diarrhœa which continue for four days or longer might be designated, in a classification founded upon morbid anatomy, as entero-colitis, and, moreover, the extent of the inflammatory changes is measured largely by the duration of the diarrhœa. In cases terminating fatally within four days, in previously healthy children, even the superficial epithelium may be normal, while in other of these cases there may be some desquamation of this layer. The cases which terminate fatally after from seven to ten days usually show more marked inflammatory changes. The mucous membrane is swollen, the villi are prominent and purplish, and the solitary and agminated follicles are congested and projecting. In more protracted cases the inflammatory process involves the deeper layers, and ulcerations in every degree, from the most superficial to those extending down to the muscular coat, may appear.

It would be as unscientific to attempt a classification of the diarrhœas of infancy founded upon pathological anatomy as it would be to designate acute, subacute, and chronic arsenical poisoning as desquamative, catarrhal, and ulcerative gastro-enteritis.

Having thus discarded all classifications founded upon morbid anatomy, what shall we select as a basis for the differentiation of the various forms of diarrhœa in infancy? The fundamental object in any classification must be to enable the physician to treat his patient most successfully. The giving of names to diseased conditions enables us to group, systematize, and most advantageously use the information which we may possess, or may in the future acquire, concerning the etiology, symptomatology, and treatment. Certainly in the class of diseased conditions now under consideration a classification founded upon etiological factors will be of greatest service in treatment. But the question which arises here is this: Do we at present know enough of the causes of these diseases to attempt a classification based upon etiology? In answer to this I reply that, while there is yet much to learn on this point, I propose to offer a provisional classification founded upon what I believe to be the most important factors in the causation of the diarrhœas

of infancy, because I believe that such a classification, imperfect as it must at present be, will be of greater service to the practitioner than one based upon the morbid anatomy, which, as we have seen, is determined more largely by the duration of the diarrhœa than by the nature of the exciting cause.

In attempting this classification we have the following facts to aid us: (1) Some of these diarrhœas are independent of seasonal influence. They occur as frequently in winter as in summer, while the prevalence of other forms is so plainly limited to the hot season that they are now quite universally designated as "summer diarrhœas." (2) Those which are apparently independent of seasonal influence do not differ from similar diseases in adult life, save in the greater susceptibility of the infant and in the greater delicacy of its organization, thus rendering the disease of more serious import in the child than in the adult. On the other hand, the so-called "summer diarrhœas" are so generally limited to the first two or three years of life that they may be regarded as peculiar to that age.

Improper or excessive feeding, acting upon the delicate organization of the child's digestive apparatus, may cause diarrhœa even when there are no toxicogenic micro-organisms present. A small quantity of some indigestible substance in the intestines may increase the peristaltic movements and lead to frequent stools. Taube and Escherich have shown that in the young child stomachic digestion is of less importance than intestinal digestion, and that the stomach is more of a receptacle into which the milk is received for coagulation than a digestive organ; thus we have the most favorable conditions for the growth and activity of the bacteria which are introduced with the food. The same investigators find that the younger the child the less active is digestion in the stomach, and that in this organ the milk is coagulated and passed through the pylorus undigested. Hammarsten has shown that this is the case in puppies and young rabbits, and Hofmeister and Tappeiner showed that the stomach does not absorb soluble substances as rapidly as does the mucous membrane of the small intestines. Zweifel states—and in this he is supported by Hammarsten—that the proteolytic activity of the pancreatic juice is relatively well developed in the new-born. The absorption of fats is dependent upon the pancreatic juice and the bile, and the teaching of Frerichs, that the milk-sugar is absorbed from the stomach, is now known to be erroneous. This constituent of milk, as has been shown by Dastré, is digested by a ferment found in the mucus of the small intestine. These experiments convince us that the digestion of milk by the infant is nearly, if not quite, altogether accomplished in the small intestine, and explain why indigestion in the infant induces diarrhœa.

The diarrhœa which results from temporary indigestion will be described under the title of Acute Intestinal Indigestion.

The continued ingestion of material indigestible in character will produce inflammatory processes leading to pathological lesions, and this condition will be considered in this paper under the head of Chronic Intestinal Indigestion.

It must now be admitted that the so-called "summer diarrhœas" of infancy are due to the growth and multiplication of bacteria and the formation of chemical poisons by these low forms of vegetable life. Since these harmful organisms are, in the great majority of cases, taken into the body in the milk which constitutes the sole or chief food of the infant, I will describe the symptoms and lesions due to these causes under the title of Milk Infection, and this will be subdivided, according to the severity and duration of the symptoms, into Acute and Subacute Milk Infection.

I would prefer the term "milk-poisoning" for the last two of these forms

of diarrhœa, but, bearing in mind the fact that "milk-poisoning" has long been used to cover another affection, I have been debarred from using it. There are, moreover, certain advantages in the adoption of the words "milk infection." These bring out more prominently the part played by bacteria in the causation. I wish to positively deny that I have been led to drop the old nomenclature and adopt a new one for the sake of introducing a novelty. I believe that the advance in our knowledge of the causation of these diarrhœas justifies the change, and that the use of the terms here suggested will, in the first place, give the physician a better idea of the cause and nature of the trouble with which he is dealing, and, secondly, it will tend to make parents more attentive to the character of the food supplied their children.

This simple classification will, as a whole, I believe, be of most service to the practitioner, and the object of this paper is to aid the physician in treatment, and not to instruct the pathologist in morbid anatomy. It must not be supposed, however, that the writer believes that this classification is perfect, or that a diarrhœa originating in one of the above-mentioned causes may not be influenced by other etiological factors. A child with a simple irritative diarrhœa is by no means immune to milk infection, and every physician knows that the intestines of an improperly-fed child furnish the best-known culture-tubes for the growth of certain harmful bacteria. For these reasons the prognosis in a case of intestinal indigestion will be influenced by the greater or less probability of there being engrafted upon this abnormal condition the more serious element of bacterial poisoning.

Acute Intestinal Indigestion.

Synonyms.—Simple diarrhœa; Irritative diarrhœa; Mechanical diarrhœa.

The number of cases of this disease is large, but, unfortunately, the physician is not frequently consulted concerning them until they have become chronic or until the supervention of bacterial poisoning renders the symptoms more grave and excites alarm. The idea that frequent stools are beneficial during teething has led to neglect of these cases, and has been an important factor in increasing infantile mortality. The prompt recognition and treatment of acute intestinal indigestion are most valuable prophylactic measures against the more serious intestinal disorders. Measured by the good which can be accomplished by proper treatment, this disease is second to none of the diarrhœal affections in importance.

Etiology.—Excessive feeding is a frequent cause of intestinal indigestion. Children fed artificially are more likely to be overfed than those nursing from the breast, for two reasons: In the first place, the supply is not so easily exhausted, and, in the second place, the child obtains the food more easily; indeed, the milk is often poured into the child's stomach *ad nauseam*. To these might be added the fact that the child is often given the nursing-bottle when the busy mother would not stop to nurse it herself. Again the system needs so much water, and too many mothers and nurses seem to be wholly ignorant of the fact that a babe might relish a little water at times. The overloading of the stomach throws upon the digestive organs more work than they can do, and the undigested portions act as foreign bodies.

Improper feeding is another fertile source of mischief. This is not the place to discuss infant-feeding, and readers are referred to the special section upon that subject. It may be remarked, however, that the custom of giving the babe a taste of various things on the table is a pernicious one. The milk of the healthy mother contains all the nourishment needed by the nursing

infant, and should constitute its sole food at this period of life. But, unfortunately, the mother is not always healthy, and she may on account of sickness, excessive menstruation, or other causes be unable to supply the demand either in proper quality or quantity. In these cases the knowledge of the most intelligent physician is often found to be too limited.

The cause of the imperfect digestion may be in the child itself. It may have tuberculosis or some other wasting disease, or the digestive organs may be functionally incapacitated by some temporary ailment. The employment of predigested food may be resorted to for the time, but its continued use is not wise. The digestive organs, like all the organs of the body, are enfeebled if relieved of their physiological duties. The too rapid absorption of peptones may be harmful, and physiologically it is questionable whether proteids which have been completely converted into peptones are ever largely utilized in the body in building up tissue. It is probably fortunate that in the great majority of instances artificial digestion is incomplete and the supposed peptones are actually albumoses.

Symptoms.—Restlessness, flatulency with abdominal pain, and sometimes vomiting, are the first symptoms of this form of diarrhœa. Then frequency of stool, often accompanied by griping pain, follows. The appearance and other physical characters of the discharges vary with the severity and continuance of the attack. At first they appear quite normal, and their frequency is the only thing to attract attention. Then they become more watery, but are not mucous, as they are when the disease becomes chronic and inflammatory, nor serous, as they often are in acute milk infection. The stools are sometimes green, and this may give rise to alarm, but this color is often due to trivial causes, and too much importance has sometimes been attached to it. After a free discharge the child becomes less restless, and may fall into a quiet sleep, from which, however, it is soon aroused by abdominal pain, which continues until the bowels are again relieved. A few hours of this pain tells upon the features; the countenance becomes pale, and its continuance for a few days lessens the rotundity of the limbs and makes the muscles soft and flabby. If the intestinal irritation be severe, convulsions may occur. Elevation of temperature is seldom observed in this form of diarrhœa, or if it does appear it is evanescent. The pulse is accelerated during the paroxysms of pain, but is usually normal during the intervals. Thirst is an accompaniment, and may be great when the stools are frequent and watery.

Prognosis.—This form of diarrhœa is not in and of itself fatal. Unless the cause of the irritation be removed, inflammatory processes are induced in the intestine, and a chronic diarrhœa results, or bacterial invasion, finding favorable soil, may speedily develop an alarming condition.

Treatment.—The prompt and judicious treatment of this form of diarrhœa is in the majority of instances highly satisfactory. The administration of all food should be forbidden for a number of hours. The exact period of this prohibition may vary with the symptoms in the individual case, but, as a rule, twenty-four hours will not be too long. The child will be restless and will cry from thirst, which should be provided for by suspending bismuth subnitrate in sterilized water, from two to five grains to the drachm, and ordering that this be given in doses of a teaspoonful or more every hour when the child is awake. The undigested food remaining in the intestines should be removed, and the best agent for the accomplishment of this purpose is castor oil, a teaspoonful of which should be given to a child one year of age. Some physicians prefer rhubarb (one to two drachms of the syrup), and others recommend magnesium sulphate, but I am sure that there is nothing which is more certain

and pleasant in its action than castor oil. It may be asked whether or not the administration of the laxative is regarded as essential in every instance. I have seen many children improve rapidly without it. In these the irritating substance has been swept out of the intestines by the diarrhœal discharges, and a small dose of opiate is all that is needed; but it is impossible to tell in a given case whether this fortunate removal has been accomplished by unaided nature or not, and the more certain method is to administer the laxative.

After the laxative has had its effect, earlier if there be great pain, an opiate in very small doses, to be repeated, if desirable, after each evacuation, is generally beneficial. The opiate may be given in the form of the tincture, the deodorized or the camphorated tincture. The custom of introducing opium into compound prescriptions ordered for children is to be condemned. It is a common practice with many physicians to write a prescription containing an opiate, bismuth subnitrate, pepsin, and chalk mixture. The pepsin is useless, because the administration of food has been prohibited, and it cannot have any digestive effect upon that which is already in the intestines. The syrup in the mixture may ferment and be harmful, and the chalk is without value, while the bismuth should be given more freely than the opiate. For these reasons the opiate should not be incorporated in a mixture, but should be prescribed by itself; and this holds good whenever opium is employed in any form of diarrhœa in infants. I have said that the dose of the opiate should be small —simply enough to allay the abnormal peristalsis of the intestines. From five to ten drops of the camphorated tincture or a half minim of either of the other tinctures will usually suffice for a dose for a child one year of age. After twelve hours of this treatment the condition of the child will usually be found to be much improved, but the diarrhœa will return as soon as the improper feeding begins. It is well to order the continuation of bismuth subnitrate at longer intervals for some days, and the physician must give his attention to the character of the food, which must now be resumed. He must endeavor to ascertain wherein the feeding was at fault, and thus avoid a repetition of the trouble. If the child is nursing and the harm has come from the giving of additional food, such addition must be forbidden. If the mother's milk is at fault, and if this cannot be improved, the selection of a good wet-nurse is the best thing that can be done. If neither of these is practicable, or if the child has been artificially fed, the selection and preparation of the best food suited to the case must be undertaken. For aid upon this point the reader is referred to the section on infant-feeding.

Chronic Intestinal Indigestion.

Synonyms.—Chronic diarrhœa; Chronic irritative diarrhœa; Chronic intestinal catarrh; Chronic entero-colitis.

Etiology.—Chronic intestinal indigestion, with consequent diarrhœa, is a common affection of infancy. The undigested food ferments, and the products of this fermentation, acting as irritants upon the sensitive mucous membrane, induce a catarrhal condition which is most marked in the ileum and colon, where ulceration not infrequently results. All this may occur without the aid of toxicogenic germs, and probably without the intervention of any adventitious bacteria whatever, since those normally present are capable of accomplishing these results when digestion is arrested or markedly retarded. Chronic intestinal indigestion may occur at any season of the year, but it becomes of more serious import during the hot months, when toxicogenic germs abound and the chances of their invasion are greatly increased. It is self-evident that

this affection is more common among those infants artificially fed than among those who draw their sole and sufficient nourishment from the breast of a healthy mother. It is equally plain that it is most prevalent among those suffering from debilitating and wasting disorders, either inherited or acquired, such as syphilis, tuberculosis, rickets, or chronic broncho-pneumonia; and among those who have had their vitality impaired by an acute infectious disease, such as pertussis, scarlatina, or measles. Children who suffer from neglect, insufficient clothing, and exposure to cold are also prone to this affection. Some children seem to be born with an inability on the part of the intestines to properly digest and absorb food. I have seen such a child weighing less when sixteen months of age than at the time of birth, and yet recovery resulted, and the child, now eight years of age, weighs as much and is as robust as the average. Frequent attacks of acute indigestion lead to the chronic form, though it is probably true that the majority of cases of chronic indigestion develop insidiously and without any marked preliminary acute attack.

Symptoms.—The discharges from the bowels become, as a rule, gradually more frequent, increasing from one to two, to from four to six or more per day. The child usually becomes nervous, fretful, and fails to sleep well. Flatulency is a more or less marked symptom, and when great the distention of the bowels may cause severe pain. The stools are generally quite characteristic in certain particulars. In consistency they may be semi-solid or more watery, or they may vary in this respect from time to time. The odor is quite invariably distinctly offensive. So marked and common is this that the stools are frequently designated as putrid. The presence of undigested food is indicated by the color. Lumps of coagulated casein and masses of unchanged fat may be seen. With the progress of the disease and the development of inflammatory changes, mucus appears, pus may be detected with the microscope, and, when hard lumps are present, they may be streaked with blood. The color will vary with the kind of food and the extent to which it fails to digest. Pale, putty-like stools are common, while the presence of a large amount of fat may render the excretions gray or even white. The green stools are quite common in this affection, and in some instances at least this coloration is due to the growth of chromogenic bacteria. There are likely to be periods of exacerbation, when the number of evacuations becomes much greater and their consistency thinner and more watery. At these times the pain usually becomes more severe, and fever, with vomiting and increased restlessness, makes the case more alarming. The diarrhœa, more or less marked, may continue for weeks. In rare instances the increased frequency of the discharges may be borne by the child for a long time in a surprising manner. The rotundity of the limbs is not lost, and the infant may not only hold its own, but may gain slightly in weight. Such cases, however, make the exceptions. Usually the child loses day by day. Emaciation becomes marked, the muscles of the limbs and the trunk melt away, and the head appears by contrast to be abnormally large. The gradual loss of substance and strength may end in exhaustion and death. However, this is not common, death in the majority of instances resulting not from the disease itself, but from the intercurrence of milk infection.

In cases terminating favorably recovery is usually a slow and gradual process, liable to many partial relapses. The child becomes less fretful and gives less evidence of pain. The stools decrease in number, and become more like the normal in form and color. The putrid odor is likely to be the most persistent evidence of the diseased condition.

Throughout the course of a chronic intestinal indigestion it often happens that the appetite is unimpaired. The child, while it is losing weight and after

it has been reduced to a mere shadow of its former self, may take more food than it did when well. It has often been observed that while such a child does not give any evidence of craving food, and while its restlessness is not increased by prolonging the intervals between feeding, it readily and, possibly, voraciously swallows any food offered; and it may seem that the larger the quantity of food taken, the more rapidly do the tissues melt away. Indeed, this is not altogether a merely apparent thing; it may be a reality. When the food is not digested, excessive feeding increases the irritation, deepens the inflammatory processes, multiplies the number of stools, draws upon the vital resources, and hastens the period of exhaustion.

The stomach often remains surprisingly free from involvement in this affection, and vomiting seldom occurs save during the exacerbations already referred to. The tongue is usually dry and red, though it may be covered heavily with a yellowish or brownish coat. Thrush and follicular stomatitis are not rarely seen, and the teeth may rapidly decay. These are, however, by no means constant symptoms. The vexatious cases of prolapsus ani in infants are most common among those suffering from chronic intestinal indigestion. The general vitality of the little patient is often so low that the replaced bowel is not retained, and when it becomes inflamed and swollen it may cause great pain. The skin with which the discharges come in contact may become highly inflamed, and, unless attention be given to frequent changes and the employment of protective powders, the inflammatory process may lead to ulceration.

The temperature is usually normal, though it may be elevated during the periods of exacerbation. A subnormal temperature persisting for some days is an alarming indication, and is usually followed by death. However, in cases of marked debility and exhaustion the extremities are generally cool, and need warm clothing and at times the application of artificial heat. The pulse becomes weak, and the respiration is often irregular and shallow. The ankles may become œdematous, and this condition does not necessarily imply nephritis, though structural changes in the kidney, with albuminuria, may occur.

Diagnosis.—The history of the case and careful inspection of the stools, which should always be made, will seldom leave any doubt in the mind of the intelligent physician concerning the correctness of his diagnosis. There is one point, however, which should always be considered in reaching a correct estimate of the nature and gravity of the individual case. I refer to the necessity of a careful examination of the child in every part of its anatomy. If attention is given exclusively to the bowels, important conditions may be overlooked. In some instances—and the number of these is not small—the failure of the digestive organs to perform their functions properly is due to the existence of some constitutional disease and to the effects of poisons generated in such an affection. On the other hand, the wasting which follows long-continued intestinal indigestion renders the child highly susceptible to the invasion of specific germs, and especially to those of tuberculosis. The diagnosis must therefore embrace any constitutional coexistent affection. Otherwise the physician is likely to be led astray in his prognosis and treatment.

Prognosis.—This will be influenced largely by the parentage of the child, by the cause of the indigestion, by the duration of the disease, by the season of the year, and by the presence or absence of constitutional disease. In some families the children are prone to digestive troubles; especially is this true when one or both parents are tuberculous or syphilitic. This is also likely to be the case when a child is born to very youthful parents. If the cause of the indigestion can be traced to some special error in diet, the chance of curing

the disease after the removal of the cause is, of course, greatly increased. The greater possibility of the supervention of milk infection leads to a less hopeful prognosis when this form of indigestion occurs during the hot months; and the coexistence of chronic broncho-pneumonia, tuberculosis, scorbutus, syphilis, or rachitis may render temporary improvement doubtful and permanent recovery impossible. Still another and most important subject to be considered in forming a prognosis is the sanitary surroundings of the patient and the probability of securing improvement when needed.

Treatment.—So long as the cause of the indigestion is unknown, the treatment is likely to be wrongly directed and ineffective. Some error in diet is suspected. If the child nurses, does it obtain all its food from this source? If the answer to this be in the affirmative, then the health of the mother must be investigated. Is she pregnant? is she exhausted by excessive menstruation, prolonged lactation, by care and loss of sleep, or by some constitutional disease? If any of these be demonstrated to be the real cause, the employment of a suitable wet-nurse, when such a rare and valuable aid in treatment can be found, is the best thing that can be done. However, it is far better to take the chances with artificial feeding than to trust the child to a dishonest, vicious, or diseased wet-nurse. I have known of more than one instance of the children of respectable parents contracting syphilis from such a woman. When the infant is artificially fed, it is not enough for the physician to merely inquire about the character of the food, but he must know how it is prepared and in what quantities and how frequently it is administered. The source of the food may be exceptionally good, but if it is kept in unclean vessels, in a contaminated atmosphere, or if it is administered in excessive quantities, the doctor's drugs will be of little service until the fault is discovered and removed. The physician who depends solely upon his prescriptions, and neglects the more important matter of diet, will not have reason to congratulate himself upon the success of his treatment. The child will often improve and gain in flesh when the quantity of its food is diminished. When the stools contain lumps of coagulated casein and masses of fat, or when they are acid from the fermentation of the sugar of milk, it is best to wholly discontinue the use of milk for some days and feed the child solely upon meat broths and egg-albumin. On the other hand, if the stools be alkaline and putrid, barley gruel, rice-water, and solutions of dextrin or soluble starch obtained by roasting or boiling wheat flour, may be used. As a rule, the indigestion is confined to the inability of the digestive fluids to act upon either the carbohydrates or the proteids. If the trouble lies in the former, the stools are likely to be acid and the formation of gas in the intestines marked. In such cases a diet consisting exclusively of proteids should be tried and continued, unless it should prove positively harmful, for three or four days, and if beneficial effects follow it may be longer continued. Proteid indigestion is likely to produce fetid, alkaline stools, and a diet of carbohydrates will prove beneficial. I do not claim that any absolute rules can be founded upon the above-mentioned facts, because fermentation of one of these food-constituents naturally and necessarily prevents the complete digestion of the other; but I do hold that the physician gains no information by continuing a mixed diet, and, although he may be in error in his first trial, he has made, as it were, a physiological test, and he is now better prepared to treat the case rationally. Many physicians recommend the employment of artificially digested milk, but my experience has led me to prefer the selection of an exclusive diet of either carbohydrates or proteids; and by this I do not mean the employment of halfway measures, but the exclusion of one of these food-principles should be complete. Moreover, there are, as I have stated,

grave physiological doubts about the capability of the organism to utilize peptones in the repair of wasted tissue.

The physician must never lose sight of the fact that chronic intestinal indigestion is accompanied and may be caused by lowered vitality and general loss of tone. Tonics are indicated, and the best of these is an abundant supply of pure, fresh air. Removal from the crowded city and its contaminations to the better air of the country, and especially to that of the mountains, is often of the greatest service, and should be urgently recommended to parents who are able to provide for such a change. Arsenic and nux vomica may be used, but they are poor substitutes for fresh air and improved sanitary surroundings. Alcohol in the form of port or sherry is often advantageous, and cod-liver oil is of service in protracted cases.

The occasional administration of laxative doses of castor oil or from two to three grains of calomel will be of service.

Opiates are to be avoided as far as possible, and are never indicated save in the painful exacerbations which may occur.

Much has been written concerning the use of intestinal antiseptics, but only a few of these are of any real value. The same is true of astringents. Bismuth subnitrate has both antiseptic and astringent properties in a mild degree, and of all such drugs it has best preserved its reputation. It should be given in large doses, fifteen grains or more, six or eight times per day, and, as in acute indigestion, it should be kept free from combination with opiates. Sodium salicylate and salol in some cases seem to be of benefit.

The lesions in the small intestines are best reached by the administration of the large doses of bismuth subnitrate, while those of the large intestine are most successfully treated by enemata. These should be employed three or four times per week. First, the bowels should be irrigated with warm water containing a little castile soap until they are completely emptied. This must be thoroughly done, and in order to secure this thoroughness the physician must either do it himself or trust it only to a trained nurse or assistant. The hips should be elevated, and a large-sized flexible catheter attached to a fountain syringe should be passed into the colon. The passage of the catheter will be facilitated by allowing the water to flow at the time. From three to four quarts of water should be used, the excess returning by the side of the tube. After the large intestines have been cleansed in this manner, one-half pint of water, containing from one to two drachms of bismuth subnitrate in suspension, should be injected and left in the bowel. Instead of the bismuth, thirty grains of tannic acid may be used. The temperature of the water, both that used in the irrigation and for the injection, should be that of the body.

The possibility of the intercurrence of serious complications should always be borne in mind and place the medical attendant on his guard. The frequency with which relapses occur necessitates continued attention to the diet, sanitary surroundings, and general health of the little patient for weeks and months after apparent recovery.

MILK INFECTION.

The diarrhœas which prevail among infants during the summer, especially in cities and among the poorer classes, produce a fearful mortality; consequently, they have given rise to much discussion concerning their nature and causation. The theories which have been advanced to explain the origin of these diarrhœas have included nearly everything which a lively imagination

could suggest. Learned arguments have been made to show that the most important etiological factors lie in mysterious and unknowable meteorological or telluric conditions; while, on the other hand, the keen perception of a medical genius detects "that the fatality of the disease has been appreciably increased by the introduction and universal use of the child's carriage." The limit set upon the writer of this paper by the editor will not permit indulgence in an historical sketch of these varied theories, nor will it allow of any argumentative discussion. I shall have to content myself with a bare statement of those etiological factors the existence of which has, in my opinion, been demonstrated.

These diarrhœas are due to toxicogenic (poison-producing) bacteria. There is not a specific micro-organism, as there is in tuberculosis, but any one or more of a large class of germs, the individual members of which differ from one another sufficiently morphologically to be regarded as distinct species, may be present and may produce the symptoms.

Only a very brief summary of our knowledge concerning the intestinal bacteria can be given here, while the reader is referred for more extended information to the works of Escherich, Booker, Baginsky, and Jeffries. The intestinal contents during fœtal life are sterile, and remain so for a short time after birth. However, within a few hours after birth bacteria find their way into the intestines. The meconium contains quite constantly two species of bacilli and a micrococcus. One of these bacilli is a long, slender rod with a bright, glistening spore, and is known as the "head-bacillus." The other appears to be identical with bacillus subtilis. The micrococcus is a large circular or elliptical organism. Breslau taught that this is taken in with the air which the child swallows immediately after birth, but Escherich thinks that these bacilli found in the rectum find entrance through the anus. However, these bacteria wholly disappear with the last passage of meconium.

The normal bacterial flora of the healthy nursing child is yet more limited, so far as species are concerned, the number being two—the bacterium lactis aerogenes and the bacterium coli commune. These are known as obligatory "milk-fæces" bacteria, and are constantly present. The upper part of the duodenum is quite free from bacteria. Lower down, the small intestines contain large numbers of the bacterium lactis aerogenes, while in the lower part of the ileum the bacterium coli commune appears, and grows more abundant in the colon, throughout the whole length of which this germ is found. Other "inconstant" bacterial forms are found in the large intestines of the healthy milk-fed child. Both the bacterium lactis aerogenes and the coli commune are pathogenic to some of the lower animals when injected subcutaneously. Whether either of these ever develop pathogenic properties in diseased conditions or not is a question which has been much discussed, but which cannot be considered as positively settled at present.

The contents of the intestines in the so-called summer diarrhœas of infancy swarm with bacteria of many species, and some of these produce most powerful poisons. These bacteria multiply outside of the body, and are disseminated widely and abundantly only when the atmospheric temperature reaches 60° F. or higher. This is the reason for the restriction of these diarrhœas to the hot months of summer.

The most suitable culture-medium for the growth of these bacteria is milk, and this is the food with which they most commonly find their way into the intestines of the child. A knowledge of these facts has led to the employment of the most effective prophylactic measures for these diarrhœas. These measures may be grouped into (*a*) those which prevent the contamination of milk, and (*b*) those which destroy any germs with which the milk has already

been contaminated. Since these diarrhœas are limited to children artificially fed in whole or in part, our prophylactic measures are devoted exclusively to cow's milk. Some years ago I formulated the following rules concerning the care necessary to prevent milk undergoing these putrefactive changes:

(*a*) The cows should be healthy, and the milk of any animal which seems indisposed should not be mixed with that from the healthy animals.

(*b*) Cows must not be fed upon swill or the refuse from breweries or glucose-factories, or upon any other fermented food.

(*c*) Milk cows must not be allowed to drink from stagnant pools, but must have access to fresh, pure water.

(*d*) The pasture must be freed from noxious weeds, and the barn and yard must be kept clean.

(*e*) The udders should be washed, then wiped dry, before each milking.

(*f*) The milk must be at once thoroughly cooled. This is best done in the summer by placing the milk-can in a tank of cold water or ice-water, the water being of the same depth as the milk in the can. It would be well if the water in the tank could be kept flowing, and this will be necessary unless ice-water is used. The tank should be thoroughly cleansed each day to prevent bad odors. The can should remain uncovered during the cooling, and the milk should be gently stirred. The temperature should be reduced to 60° F. or lower within an hour. The can should remain in the cold water until ready for delivery.

(*g*) Milk should be delivered during the summer in refrigerator cans or in bottles about which ice is packed during transportation.

(*h*) When received by the consumer it must be kept in a clean place and at a temperature some degrees below 60° F.

If all the milk used in the artificial feeding of infants could be obtained and marketed with the care demanded by the above rules, milk infection would be practically unknown and the sterilization of the infant's food would be unnecessary. However, since it is impossible for the city consumer to know that the milk, which has been transported through a long distance and has passed through the hands of several dealers, has been kept from infection, the only safe plan for him to adopt consists in the sterilization of all of that which is fed to children. There is no doubt in the mind of the writer that wholesome, uninfected milk in the raw state is a better food for the infant than cooked milk. The heat of sterilization robs the nuclein of the milk of its vital properties, as can be demonstrated by experiments. But I am equally positive that it is better to feed the city child upon sterilized milk than it is to use that which, with the prevailing ignorance and carelessness of dairymen and dealers, is likely to be infected. The risk in using unsterilized milk is too great, and the question with the parent or physician is not, Am I giving the child the best food? but, Am I giving it a poison? The choice is easily made when the matter is looked at in this light.

The toxicogenic germs grow and multiply in the milk both before and after it has been taken into the alimentary canal of the child, and elaborate chemical poisons which induce the diarrhœa and other untoward symptoms. The number of these poisons is probably as great as that of the bacteria which produce them. While they may differ in the intensity of their toxic properties, all are gastro-intestinal irritants, just as we have a number of metallic poisons which act in a similar manner. Some of these poisons have been isolated and their effects upon the lower animals have been studied. Tyrotoxicon, first found in poisonous cheese, later in ice-cream and other milk-products, has been isolated from a sample of milk a part of which had been administered to a healthy child

and had caused a severe choleriform diarrhœa. This is a most potent poison, inducing severe and continued vomiting and purging with speedy prostration, and death within a few hours if the quantity administered is sufficient. Post-mortem examination shows but little change. The mucous membrane of the small intestine is bleached and softened, and possibly deprived here and there of its superficial epithelium. These are the symptoms and the post-mortem appearances in the choleriform diarrhœa of infants.

In 1890 proteid poisons were isolated by the writer from cultures of three of the toxicogenic germs found by Booker in the intestines of infants suffering from milk infection. These proteids are highly poisonous, and when injected under the skin of kittens or puppies they cause vomiting and purging, and, when employed in sufficient quantity, collapse and death. Post-mortem examination shows the small intestine pale throughout and constricted in places. The heart has been invariably, so far, found in diastole and filled with blood.

A small amount of the proteid from bacillus *x*, dissolved in water, was injected under the skin on the back of a kitten. Within one half hour the animal began to vomit and purge, and death resulted within eighteen hours. The small intestines were pale, contracted in places, and contained a frothy mucus. The stomach was distended with gas, and contained mucus stained yellow with bile. The liver was normal, the spleen and kidneys were congested, and the heart was distended.

Another kitten was treated with the proteid from bacillus *a*, dissolved in water. The vomited and fæcal matters in this case were green. The animal died after fifteen hours, and presented appearances practically identical with those mentioned above.

A third kitten was treated with some of the proteid from bacillus A, suspended in water, and presented substantially the same symptoms and post-mortem appearances.

Concerning the amount of one of these proteids necessary to produce a fatal result in the animals experimented upon the following tests were made: Fifteen milligrammes of the dry proteid from bacillus *a* was injected under the skin of the back of a guinea-pig. This caused death within twelve hours. Of two kittens treated with fifteen milligrammes of the *a* proteid, one died after forty-eight hours, and the other recovered after two days of vomiting and purging. Two puppies of about five pounds weight had each forty milligrammes, and after serious illness of two days speedily recovered. During these two days of vomiting and purging these dogs were constantly shivering as with cold, but the rectal temperature stood at from 102.5° to 103.5° F.

Baginsky and Stadthagen have isolated from cultures of the "white liquefying germ" obtained by the former from diarrhœal stools a poisonous proteid which produces in mice, after about five hours, slight dyspnœa. The coat becomes rough, the animal sits with drooping head, and when forced to move does so sluggishly, but without any evidence of paralysis. The marked apathy increases, and death results after two or three days. Section shows an infiltration about the place of injection, congestion of the spleen, liver, and peritoneum. The intestine is hyperæmic throughout its entire length, and its upper portion contains a reddish-brown fluid. The same bacterium produces a poisonous base.

With our present knowledge of infected milk and the chemical poisons which may be generated therein the causation of the summer diarrhœas in infancy has been divested of the mystery which formerly obscured our views. Uninfected milk improperly administered may, as we have seen, cause intestinal

indigestion, and thus prepare the way for milk infection; but it can never directly induce the severer forms of diarrhœa which make infantile mortality so alarmingly great. The relation between these forms of diarrhœa may be likened to that between catching cold and infection with tuberculosis. The popular idea is that tuberculosis originates in frequent colds, but the physician knows that this is not true, and that the only causal relation between the two is that which grows out of the lowered vitality, lessened resistance, and greater susceptibility. If parents were willing to pay for wholesome, uninfected milk half the fancy price which they readily give for some prepared baby food, their children would be better nourished and disease among them would be less frequent.

Acute Milk Infection.

Synonyms.—Cholera infantum; Choleriform diarrhœa.

Etiology.—Fortunately, this form of milk infection is not so common as those of a milder type. It practically never occurs among children fed exclusively from the breast. The exceptions to this, if there be such, must arise from the introduction of powerful toxicogenic germs into the alimentary canal in some unusual manner. There are recorded cases in which, after a night of debauch, the milk of a wet-nurse has proved intensely poisonous to the child. It may possibly happen that an infant creeping about a filthy apartment, and investigating every object upon which it can lay its hands, by the sense of taste or by sucking its dirty fingers, may thus infect itself. It may also happen that a like misfortune may result from bacteria taken from the exterior of the breast of a filthy mother. However, as stated above, these are unusual methods of infection, and the rule holds good that choleriform diarrhœa is limited to the artificially fed.

The diligent researches of able bacteriologists—among whom Booker and Jeffries in this country and Escherich and Baginsky in Germany deserve mention—have failed to discover a specific micro-organism in cholera infantum. Booker found bacteria belonging to the proteus group most frequent in these cases.

As has been stated, the writer found tyrotoxicon in one sample of milk, the administration of which to a healthy child was followed within two hours by the development of a most violent form of this kind of poisoning. This demonstrates that the poison may exist preformed in the milk at the time of its administration. Holt has observed that cholera infantum "is most frequently engrafted upon a mild dyspeptic diarrhœa." This is undoubtedly often the case, but it so happens that in the writer's experience the violent symptoms have suddenly appeared in previously healthy children, and Christopher makes a similar observation. It certainly is an error to say that acute milk infection begins as a mild diarrhœa. The former may supervene on the latter, but one is no part of the other.

Choleriform diarrhœa never occurs save in the hot months of summer, at a time when poison-producing germs are most abundantly distributed. The cause is invariably in the food, and the poisons which induce the symptoms are not known to originate in any other food than milk or some milk preparation. I saw one case in a child fed upon condensed milk, and the mother noticed when she opened the can that the ends were distended by accumulated gases, and the first feeding from this can was followed by severe vomiting and purging. Bacteria were abundant in the contents of the can. Another case resulted from the first feeding from a can of a baby-food preparation. Every case of this affection is one of poisoning from the elaboration of chemical products by the growth of

bacteria in milk. There may be enough of the poison in the food at the time of its administration to develop the symptoms as quickly as they would result from the giving of a poisonous dose of arsenic, or the greater part of the toxic substance may be generated by the growth of the bacteria in the alimentary canal.

Symptoms.—No one can see a little patient suffering from acute milk infection without being deeply impressed with the similarity of the symptoms with those induced by some powerful gastro-intestinal irritant. The child, which may have been perfectly well or suffering from some mild form of diarrhœa, suddenly begins to vomit and purge. These symptoms may continue almost incessantly until death results within a few hours. The color leaves the face, and a deathly pallor spreads over the countenance. The eyes sink into their sockets, while anxiety and alarm make themselves visible in every feature. Any food-contents of the stomach are soon removed by the vomiting, but this distressing symptom continues, and mucus colored with bile is thrown off. The frequency of the vomiting is increased by the administration of food or drink. The stools at first contain formed fæcal matter and undigested food; then they become more watery and copious, and at last they are composed almost solely of blood-serum. At first they are yellow or green, but as they become more abundant they lose all color. The odor is peculiar and musty. Thirty or more stools may be passed in the severer cases within twenty-four hours. So long as the stools contain undigested food they may be acid, but the serous passages are alkaline. The flesh rapidly disappears, and there is no other disease, with the exception of Asiatic cholera, in which the wasting proceeds more speedily and exhaustion results more quickly. The skin is usually cool and clammy, but the rectal temperature is elevated, usually from 102° to 104° F., and in the severer cases it may read as high as 107° or 108° before death. The pulse is weak, thready, and rapid. The respirations are shallow, irregular, and hurried. At first the child cries, then only moans, and later falls into a comatose condition, but there may be great restlessness, wild delirium, and convulsions. Thirst is usually great, and everything offered is swallowed and almost immediately vomited. The abdomen is not distended, but is usually retracted. Sometimes the vomiting and purging suddenly cease, and the parents are rejoiced at this apparently favorable turn. However, it may be but the precursor of death. The physician is not cheered by the cessation of these symptoms if the child remains in a stupor, for this is most likely to deepen into coma.

In rare instances the child quickly passes into an algid state in which the temperature is subnormal. This indicates that the amount of the poison absorbed is large and the chances of recovery are small. In these cases the child lies in a stupor, with the eyelids half open and the eyes apparently covered with a film. The angles of the mouth are retracted and the lips open. The fontanelle is depressed, the pulse weak, and the respiration irregular. The urine is scanty and there may be complete suppression.

In other cases the symptoms are not so grave as those indicated above. The stools are not so frequent and copious, and the vomiting not so incessant. The little patient may brighten up at intervals, and sufficient of the poison may be removed by the vomiting and purging to give great relief and lead to speedy recovery.

Cases of acute milk infection terminate either in death or in marked improvement within forty-eight or at the most seventy-two hours. The improvement may be rapid and complete, or it may reach a certain point and there remain comparatively stationary.

Diagnosis.—There is only one disease which presents symptoms with which those resulting from acute milk infection can be confounded. This is Asiatic cholera, and at times of the prevalence of this foreign scourge a differential diagnosis between the two cannot be made without the aid of a bacteriological study of the stools. At all other times the suddenness of the onset, the incessant vomiting, the frequent and copious watery stools, and the speedy prostration are so striking and characteristic that there can be no hesitancy in making a diagnosis. It is true that some writers have tried to confound acute milk infection and sunstroke. The points of similarity are the suddenness of the prostration and the high temperature, but in the former of these there is a difference. The prostration of sunstroke is like a lightning flash, while in milk infection it develops only after a few hours. In thermic fever there may be one or two copious discharges from the bowels, but frequent purging does not occur and the stools are never serous. The attempt to make acute milk infection identical with thermic fever arose from our former ignorance of the existence of the powerful poisons which may be elaborated in milk, and the idea does not now find any support.

Prognosis.—It is quite necessary that the physician appreciate the gravity of these cases of acute milk infection. The usual termination is in death. The physician who speaks too hopefully in the first hours of the attack is likely to find himself disappointed in a very short time. The more persistent the vomiting and purging, and the more marked the nervous symptoms, the less are the chances of recovery. If the stools become less frequent and less watery, and if at the same time the pulse grows less frequent and stronger and the nervous symptoms improve, hope may be indulged in, but in the most favorable cases there is always the possibility of a relapse into the subacute form, and so long as this continues danger is imminent. Unfortunately, the name "cholera infantum" has been made to cover all the diarrhœas prevailing during hot months, and the physician must not be led astray by the reported success of various methods of treatment.

Treatment.—These are cases of acute poisoning, and prompt, energetic treatment is demanded as truly as if the child had swallowed a toxic dose of arsenic or antimony. It is certainly true that the physician who hesitates or temporizes loses his patient.

The first thing to be done is to positively forbid the further administration of the poison. *Not a drop of milk should be given.* This is a *sine quâ non* in the treatment. This prohibition of milk must be absolute. Sterilized milk is not to be thought of, and even the breast of the mother or wet-nurse must be denied. Prepared baby foods should be thrown out of the window. The most dangerous foe with whom the doctor has to contend in the treatment is the grandmother or other good-hearted old lady, who knows just what will agree with the baby, and who persists in giving it food as soon as the doctor turns his back. The most valuable ally that he can have is a trained, conscientious nurse who will carry out directions to the letter.

The second thing to do is to remove so far as is possible the poison already in the alimentary canal. Take a lesson from nature. The vomiting and purging are attempts to eliminate the harmful substance, but, like many other attempts on the part of nature, they are ineffectual and exhausting. Wash out the stomach and intestines on the first appearance of the symptoms. Do not postpone these measures in the hope that resort to them may not be necessary. What would be thought of the physician who when called to see a person who had swallowed a drachm of white arsenic should say, "Well, the symptoms are not at present alarming; I will call around after a few hours, and if it be

necessary I will then wash out the stomach"? Acute milk infection is poisoning with a substance more powerful and deadly than white arsenic. The washing of the stomach and intestine will not exhaust the little patient half so much as the continued vomiting and purging, and the artificial measures are much more effective. The bowels should be thoroughly irrigated with warm water and castile soap, not less than a gallon of the water being used. After the large intestine has been cleansed in this manner, an injection of cool water, containing fifteen to thirty grains of tannic acid to the pint, should immediately follow. Some of the poisons formed are, as we have seen, proteids which are precipitated by tannic acid, but until the great mass of proteid in the large intestine has been removed no good can be expected from this agent. The object of the tannic-acid irrigation is to render inert any soluble poisonous proteids which may remain in the intestines after the first washing.

The stomach should be washed with warm water containing a teaspoonful of common salt to the pint. After this organ has been thoroughly cleansed, from three to five grains of calomel should be administered.

These irrigations should be repeated as soon as the vomiting or purging returns. These may appear to be heroic measures, but the strength of the patient is conserved thereby to the extent to which the vomiting and purging are allayed.

The calomel is given for its antifermentative action and in order to reach the small intestines, which are inaccessible by the processes of irrigation.

After the vomiting has been allayed by irrigation, stimulants may be given by the mouth. I prefer whiskey to all other alcoholic stimulants. Brandy, if pure, would be equally good, possibly better, but unadulterated brandy is a rare article in this country, while good whiskey is easily obtainable. The stimulant is best given in ice-cold water (the water should be boiled, and then ice-packed about the container; the ice should not be put in the water) containing 0.1 per cent. of hydrochloric acid. This dilute acid may be used at any time to allay thirst.

I agree with Holt that the hypodermatic use of very small doses of morphine and atropine (one-hundredth of a grain of the former and one eight-hundredth of the latter) may be of benefit as a heart stimulant, but the dose must not be repeated too frequently. I have feared digitaline too much to try it in these cases, nor have I employed sparteine.

When the temperature is above 103°, an ice-cap on the head is desirable, and in some instances it seems to favorably affect the vomiting. When the temperature goes up to 104° or higher, some more efficient means of reducing it should be resorted to. The use of the coal-tar derivatives for this purpose is not to be considered, and the same may be said of all drugs. Frequent sponging and friction with cloths wet with cold water may be sufficient. The friction is important on account of the coldness of the surface. When the temperature is more alarming, the child should be placed in warm water, and the temperature of this gradually lowered by the addition of ice to 85°, the child being rubbed all the while it is in the bath. It should not be kept in the bath more than ten minutes after the temperature has been lowered to the above-mentioned point. Bathing the extremities in hot mustard-water and the use of friction are beneficial in the state of collapse.

With the exception of the above-mentioned stimulants the child should have no food for twenty-four hours or even longer. Then warm meat broths, given a teaspoonful at a time, and to be discontinued if they provoke vomiting, are most likely to be borne. The absolute prohibition of milk should hold good for several days.

There is scarcely a drug which has been shown to have, or supposed to have, germicidal properties that has not been used in this disease. Among others, mercuric chloride, carbolic acid, creasote, salicylate of sodium, benzoate of sodium, salol, naphthalin, and resorcin may be mentioned. These and others may be given by the mouth and by the rectum. Much harm and no good can be obtained from them. To attempt to disinfect the alimentary canal by means of these agents is a waste of time and energy which might be given to the more rational treatment outlined above.

The diapers from children suffering from milk infection should always be disinfected, and, what is of more importance, the nurse's hands should be disinfected after she has removed the diaper.

Subacute Milk Infection.

Synonyms.—Summer diarrhœa; Gastro-intestinal catarrh; Infectious diarrhœa; Entero-colitis.

Etiology.—This is the disease which carries off so many thousands of children in the large cities every summer. It prevails only during the hot months, when the atmospheric temperature stands above 60° F. for several consecutive days. It is due to the action of poisons generated by the growth and multiplication of bacteria. These germs are certainly more widely distributed than those which induce the symptoms described under Acute Milk Infection, but the chemical poisons produced by the former are less powerfully toxic than those of the latter. However, the milder poisons induce the greater number of deaths, on account of the greater number of individuals invaded by the germs which produce them. There are also greater variations in the symptoms of subacute cases. When the chemical poisons have been studied more thoroughly, these variations will doubtless be better understood and a more exact classification of them can be made.

Symptoms.—In the milder forms the symptoms gradually develop. The movements of the bowels increase in frequency and become more watery. They consist largely of undigested food, and contain lumps of coagulated casein and masses of fat. The color may be brown, yellow, or green, and the odor, though it may be disagreeable, has not the peculiar putrid property characteristic of chronic intestinal indigestion. J. Lewis Smith has made a microscopical study of the fæces, and has the following to say concerning them: "In addition to undigested casein, I have found epithelial cells, single or in clusters (sometimes regularly arranged as if detached in mass from the villi), fibres of meat, crystalline formations, mucus, and occasionally blood. In one instance I observed an appearance resembling three or four crypts of Lieberkühn united, probably thrown off by ulceration. If the stools are green, colored masses of various sizes, but mostly small, are also seen under the microscope."

The continuance of the intestinal fermentation sets up inflammatory processes, and the stools then contain mucus. This condition may go on for weeks, and the anatomical changes in the intestines become gradually more serious. Ulcerations may occur, especially in the ileum and colon. The general nutrition of the child becomes impaired, the appetite is not good, the tongue is covered with a white or grayish coat, and there is a gradual loss of flesh. The temperature is the best indication of the rapidity with which inflammatory changes are occurring in the intestines. There is always fever, at least during some portion of the twenty-four hours, but in the milder cases it may be so slight that it is likely to escape detection. These cases, in the earlier stages

and before marked inflammatory changes have occurred in the intestines, are often readily amenable to treatment, especially to proper change in food, and marked improvement may be produced in a short time. Other cases are more obstinate and drag on for weeks, and are likely to terminate fatally from some exacerbation, from exhaustion, or from some intercurrent disease. Children who have suffered from this slow poisoning during the summer are likely to fall victims to pneumonia the succeeding winter.

In these protracted cases there is usually more or less vomiting. This may be an early symptom, in which case it is due to fermentation in the stomach; or it may appear later when stomachic digestion is impaired by the general failure in nutrition. The vomiting is not so incessant as it is in acute milk infection.

During the progress of the protracted cases there are likely to be many exacerbations, or acute infection may result from the introduction of more virulent toxicogenic germs.

In other instances the development of these symptoms is more abrupt. The child becomes restless, and cries with pain due to distention of the intestines with gas, and there may be convulsions. Vomiting occurs early, and the temperature may rise to 103°. The diarrhœa begins, and the expulsion of the stools is accompanied by large quantities of gas. This gives relief from the pain, the nervous symptoms disappear, and the child falls asleep, from which it is soon awakened by new accumulations of gas. In these cases unaided nature is frequently successful in removing the offending contents of the intestines, and unless the administration of infected food is continued a speedy return to health may follow. Under other conditions the severe initial symptoms abate, but putrefactive processes continue in the intestines for an indefinite period of time.

Whether the symptoms come on gradually or begin more abruptly, the continuance of bacterial fermentation in the intestines leads to the development of those anatomical changes which constitute what is generally designated as entero-colitis. That the fermented intestinal contents are irritant in their action is shown by the erythema which appears on the buttocks and thighs when frequently soiled by the discharges, and which may develop into superficial ulceration of the skin. It is generally believed that the structural changes in the intestines are due to the direct action of the bacteria on the intestines, but these alterations are more probably due to the irritating action of the chemical products of the germs. The upper parts of the small intestines, the duodenum and the jejunum, are generally free from inflammatory changes, which are marked in the lower part of the ileum. This is easily explained by the fact that the contents of the small intestines accumulate here before passing through the ileo-cæcal valve. If the destructive processes in the intestinal walls were due to the direct action of the bacteria burrowing into the tissue, the explanation of the location of the catarrhal inflammation and the ulceration in the lower ileum would not be easy. Inflammatory changes in the colon are invariably present in protracted cases, and they are generally more marked than those of the small intestines, due to the fact that the intestinal contents become more irritating the longer they are subjected to the fermentative action of the bacteria. While the anatomical changes are frequently found along the entire course of the colon from the ileo-cæcal valve to the sigmoid flexure, they are most marked just above the last-mentioned point. This is again explained by the delay which occurs here in the passage of the irritating substance. The rectum is usually free from inflammatory lesions, or shows only those of the most superficial character.

The extent to which these anatomical lesions are developed depends upon the character and quantity of the irritating substances formed, but most of all upon the duration of the diarrhœa. A milder irritant acting through a longer time may cause deeper and more dangerous tissue-changes than a more powerful agent acting for a shorter time. The character and extent of these lesions may be to some extent judged by the contents of the stools. There may be much fluid mucus in the passages, and in such cases it is customary to say that the child is suffering from "catarrhal diarrhœa," or there may be lumps or clots of mucus stained with blood, and this is designated as "dysenteric diarrhœa." The presence of shreds of mucous membrane has led to the use of the term "croupous diarrhœa," and the detection of considerable pus is deemed sufficient to pronounce the case one of "follicular ulceration." However, as all of these changes may result from one and the same poison in different degrees of concentration or acting through varying periods of time, a classification based on the anatomical lesions is wholly irrational. It must not be concluded from this repudiation of an anatomical basis of classification that the physician should pay no attention to the stools. Careful inspection should be made frequently, and the statements of attendants should not be relied upon to the extent of failing to give this matter personal attention. Because one knows that his patient is poisoned with arsenic, this is no reason why he should shut his eyes to the amount and extent of gastro-intestinal irritation caused by the poison, or even to the condition of the circulation, respiration, and nervous functions. Learn all you can about your patient, and you will often find yourself even then knowing too little to effect a cure.

Complications.—Erythema of the buttocks and thighs from the irritation of the discharges is frequent, and, as has been stated, superficial ulceration may be developed and may form a very distressing complication. Thorough cleansing, the use of a mild soap, and subsequent dusting with starch or other protective powder should be advised.

Boils over the head and face often appear, and the destruction of tissue may be so deep that permanent scars are formed.

In strumous children the lymphatic glands in the inguinal region, more rarely those about the throat, may enlarge and possibly suppurate. I once saw a case in which the suppuration from the glands of the neck was so profuse that it endangered life. The urine, which was normal before the glands began to swell, contained a considerable quantity of blood, and the hæmaturia continued for more than a week. The glands were freely opened and antiseptically treated, and the child ultimately recovered completely.

In the great majority of these cases the stomach remains surprisingly free from any lesion, and this is true even when there has been frequent vomiting. In a small number some hyperæmia of the mucous membrane of this organ is found after death, and in rare instances minute ulcers have been observed.

Stomatitis is frequently a complication, and aphthous ulceration an occasional one.

Hypostatic congestion of the lungs is frequent, and a subacute bronchopneumonia is a common complication of this form of diarrhœa. It is most marked in the posterior and dependent portions of the lungs, and it often constitutes the immediate cause of death. The condition of the patient in protracted cases renders it specially susceptible to specific micro-organisms, and tuberculosis is sometimes developed.

Holt thinks that the frequency of nephritis as a complication has been overestimated since the writings of Kjellberg called attention to it, and J. Lewis Smith doubts the correctness of generally attributing the vomiting to uræmic

poisoning. My own observation and belief support the views of these American authorities.

Diagnosis.—Subacute milk infection is distinguished from the acute form by the milder character of the former. The vomiting and purging are less violent, the temperature does not rise so high, the prostration is not so great, and the large serous stools, so characteristic of the acute form, are wanting. From chronic intestinal indigestion there may be great difficulty in making a differential diagnosis. The season of the year, the character of the food, and the hygienic surroundings must be taken into consideration. The temperature is also another valuable indication, as an elevation is exceptional in indigestion except during periods of exacerbation. From intussusception, subacute milk infection is to be distinguished by the suddenness and violence of the attack, the tenesmus and pain, the absence of fever, and the stercoraceous vomiting which characterize the former.

Prognosis.—As in the case of chronic intestinal indigestion, the prognosis will be influenced by the parentage of the child, by its sanitary surroundings, and by the period of time through which the poisoning has continued, and consequently by the extent and character of the anatomical lesions. Cases developing at the beginning of a hot summer, especially when the parents are not able to transfer the child from the crowded and possibly filthy quarter of a city to a salubrious country place, are less likely to recover than those occurring among the same classes late in the fall. The probability of relapses, when the surroundings remain unfavorable, should always be borne in mind.

Treatment.—Preventive treatment intelligently carried out would save thousands of lives annually in our large cities. The best of all these measures is that the mother should nurse the child, and the mother who allows anything short of absolute inability to prevent her doing so places the life of her child in jeopardy. Daily bathing should be practised; and again I must call attention to the desirability of having nurses disinfect their hands after they have changed the diapers of the infant. This should be done whether the child is sick or well. Reports showing that all the children in a hospital fed by a certain nurse have simultaneously developed a diarrhœa, while those fed with the same food by other nurses have remained well, are given by some writers in order to prove the contagious character of the disease. It is more than likely that these cases were due to direct infection of the food from the hands of the nurse or from the use of unclean receptacles. Soiled diapers, even those from healthy infants, should not be allowed to dry in the air which children breathe. When the mother cannot nurse her infant, the fresh, uncooked, uninfected milk of a healthy cow is the best substitute. When this cannot be obtained with any certainty, sterilized milk is the next best food from a prophylactic standpoint. Fresh air, and plenty of exercise in it, are essential to the proper growth of the child.

When we come to the curative treatment the question of feeding is one of the most perplexing with which the physician has to deal, and the writer rejoices that for the details on this point he can refer the reader to the high authority who deals with the subject of Infant-feeding in this volume. However, it is not fair to shirk all responsibility in this matter, and a brief statement of the dietetic treatment will be given.

We will assume that the child has been artificially fed in whole or in part. All milk food should be prohibited for from two to four days, possibly longer. Escherich has shown that the bacterial flora of the infant's intestines changes radically and speedily when milk is excluded from the diet. In fact, this is one of the most potent agents at our command for destroying toxicogenic germs

in the intestines. Their best culture-medium is milk, and in this they will thrive and multiply most abundantly. Exclude milk from the food, and these bacteria give place to others which, if toxicogenic at all, are less powerfully so. The proteids of the milk may be replaced by animal broths and solutions of egg-albumin, which should always be freshly prepared. The meat extracts of trade are worse than worthless in these cases. Their nutritive value is practically zero. They contain extractives which may be used as stimulants, but these are not specially indicated in the cases now under discussion. The carbohydrates are best supplied in the form of soluble starch and dextrin, obtained by boiling rice or arrow-root or by baking these or other foods rich in starches. A return to a milk diet should be made cautiously: sterilized milk should be employed, and at first in very small quantities, the greater part of the food still consisting of the articles mentioned above.

Shall the medicinal treatment be begun by the administration of a laxative? The answer to this depends upon the period in the development of the disease when the physician first sees the patient. In dispensary work, and often in private practice, the physician does not see these cases until the diarrhœa has persisted for days, possibly for weeks, and after the little one has been dosed with domestic remedies, which are practically unlimited in number and variety. If the child is seen early, give from one to two teaspoonfuls of castor oil, followed by one or two drops of the tincture of opium. If, on the other hand, the child is already exhausted from the continuance of the diarrhœa, begin at once the administration of stimulants, whiskey or brandy, and give opium in small doses, which may be repeated sufficiently to allay any pain and lessen the peristaltic action of the intestines, but never sufficiently to induce constipation. Irrigation of the intestines, as before described, should be resorted to in all cases. After the large intestine has been cleansed by irrigation, from two to three drachms of bismuth subnitrate should be suspended in from six to eight ounces of water and retained as long as possible. The irrigation of the intestines, with the subsequent injection, may be practised from two to four times per week so long as the stools remain abnormal. Tannic acid, ten to fifteen grains to the ounce of water, may be used instead of the bismuth. Irrigation of the stomach is seldom indicated—never unless the vomiting be a marked symptom. Bismuth subnitrate suspended in water or in some mucilaginous drink should be given by the mouth in quantities of one or two drachms per day.

Antiseptics are practically without value, and, as unnecessary dosing is certainly to be avoided, medication should be without them. The astringents, both vegetable and mineral, such as catechu, coto-bark, silver nitrate, and lead acetate, which are so frequently found in diarrhœa mixtures, are not only valueless when given by the mouth, but they are likely to interfere with the digestive action of the stomach, which, as we have seen, usually escapes involvement in the diseased process, and consequently they are harmful.

In protracted cases general tonic treatment is often of great value. Dilute nitro-hydrochloric acid, three or four drops in as many ounces of water, is one of the best in the list of tonics. Fowler's solution, two or three drops three times per day, may be of service, and the tincture of nux vomica has been much praised. Iron and cod-liver oil are most appropriate after the digestive disturbances have disappeared.

In the more acute forms, where tenesmus is marked, relief may be obtained by the use of suppositories containing one-fourth of a grain of cocaine. Hot applications over the abdomen may also be of value.

I must again emphasize the need of attention to the local sanitary con-

ditions in all cases of milk infection. These are of more importance than the climatic influences; and, moreover, the former can be improved, while the latter can be bettered only by a change in residence. Unhygienic surroundings tell most unfavorably upon the young child, whose organism requires time in order to adapt itself to its environment.

DYSENTERY.[1]

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Dysentery is an inflammation of the mucous membrane of the large intestine. In retaining the term "dysentery" in the nomenclature of diseases of the intestines it is not because it is recognized as a distinct form of disease, but because it is a convenient term to express the most prominent symptoms resulting from the lesions in the colon and rectum.

There are three varieties—the catarrhal, the diphtheritic, and the amœbic.

I. Catarrhal Dysentery.

This affection may be acute or chronic, sporadic, endemic, or epidemic.

Etiology.—Catarrhal dysentery may occur at any age from birth to puberty, but it is most frequent between the first and tenth year as an independent affection. Sex exerts no influence, as it occurs as frequently in boys as in girls; and the same statement is true of race; so if it happen to occur more generally among any particular nationality in a community, it must be attributed to other than racial influence. It occurs under all social conditions from the highest to the lowest, and, while it is more prevalent among the pauper and laboring classes, its severity is not tempered by high social standing. It is more frequent in the city than in the country, but occurs in the latter with as great severity as in the former. Neglect, poverty, ill-ventilated and uncleanly apartments, and insufficient and foul clothing act as predisposing causes by depressing the general resisting powers of the child. Hence it is met with more frequently among the inhabitants of the tenement-houses than among those in sanitary dwellings. The liability to dysentery is increased by such vices of constitution as tuberculosis, congenital syphilis, rickets, and athrepsia, which enfeeble the general health.

As dysentery frequently occurs during the period of the eruption of the deciduous teeth, there is a popular belief that it is the direct result of dentition. After careful observation and study of the relation of dentition to diseases of the alimentary tract in 288 infants, the author feels free to assert that neither the evolution nor eruption of the teeth was found to be an etiological factor in any of them. Similar investigations may convince the skeptical that improper alimentation, and not "teething," is the most potent etiological factor in the disorders of the alimentary tract of infants. So in order to establish a direct relation between dentition and dysentery every other etiological factor must be excluded.

The most frequent as well as the most powerful causative factor is improper

[1] At the meeting of the American Pediatric Society, held at West Point in May 1893, it was agreed to drop the term "Dysentery" from the nomenclature of diseases and substitute for it "Ileo-Colitis."

feeding. The food may be faulty in quality or quantity, or in both. Pure food may act deleteriously if given in too large quantities; and the correct amount of impure food will certainly prove injurious. It occurs most often in the artificially fed, although the nursling is not exempt. The former is not only subjected to the perils of impure or ill-prepared cow's milk, but also to the dangers of the indiscriminate use of indigestible "table-food." We frequently see a baby lying in its crib or carriage with a half-filled bottle of decomposed cow's milk, or, still worse, a concoction of some patent "infant food," lying beside him, to the foul fly-infected tip of which he applies his lips for comfort day and night. Changing the drinking-water, whether it be impregnated with harmful germs or not, may irritate the intestinal canal. The author has in his possession records of at least fifty children who undoubtedly contracted dysentery by drinking the water from an impure city well. In this instance the disease prevailed very generally among the children in an area of several blocks, but those who did not use that pump-water were almost entirely exempt. Seeds, uncooked vegetables, unripe or decayed fruit, toys, coins, and many other indigestible substances may induce dysentery by injuring the intestines in their passage through them. Weaning has been noted by some as an etiological factor, but it must be remembered that coincident with it is the introduction of artificial food—a recognized factor. Sudden changes of temperature, particularly sudden and rapid falls, or exposure to draughts of air, may chill the body and cause dysentery. It is now very generally accepted that bacteria play an important part in the production of this disease, but as yet experimentation has failed to detect a specific germ for the catarrhal form. Finally, the anatomical lesions of catarrhal dysentery vary so much that we are forced to the inevitable conclusion that no single etiological factor will cause them.

Morbid Anatomy.—The lesions of catarrhal dysentery are usually confined to the lower part of the colon and rectum, but in some cases may extend along the upper part of the colon, and even into the ileum. They are characterized by more or less intense hyperæmia of the mucous membrane, either general or confined to circumscribed areas, and there may be slight punctiform hæmorrhages into the mucosa or submucosa. The congested mucous membrane varies in color from bright-red to dark-purple, and is never uniform; it is usually covered with thick, tenacious mucus. The large intestine is usually empty, while the small is distended with gas and contains a thin greenish fluid. The mucous membrane is commonly swollen and grayish in color. The solitary lymph-follicles along the colon are swollen, sometimes to the size of a small bean, and surrounded by an area of hyperæmia. Between these inflamed areas the mucous membrane is normal in appearance. Ulceration may take place. The ulcers at first are round and superficial, but soon enlarge, two or more coalescing and forming ulcers from one-half to one inch in diameter, often exposing the muscular coat of the intestine. Their edges are everted and flattened, and they assume an irregular, serpentine, or rodent shape. Ulcerations in different stages of development may often be found in the same individual. Patches resembling pseudo-membrane may also be found. Cicatrization begins upon the floor of the ulcer, its edges being drawn toward the base. Perforation and peritonitis, which are seldom seen in children, may result from the ulcerative process extending through the intestinal coats. The liver, which is usually congested, may be the seat of multiple abscesses. The mesenteric glands are enlarged and softened and dark blue in color.

Bouchut found thrombi in the sinuses of the dura mater in 35 of the 38 children who had died of "dysenteric convulsions," and in the other 3, en-

cephalitis. Busey verified by his cases the results obtained by Bouchut. Cerebral anæmia, which is the commonly accepted cause of convulsions or death, may be found alone or coexisting with thrombosis of the sinuses of the dura mater. Busey has also observed, in a few fatal cases in very young children, œdema of the lower extremities and discoloration of the skin of the feet and legs, which he attributes to the formation of thrombi in the pelvic veins, causing venous stasis and serous transudation into the subcutaneous tissues.

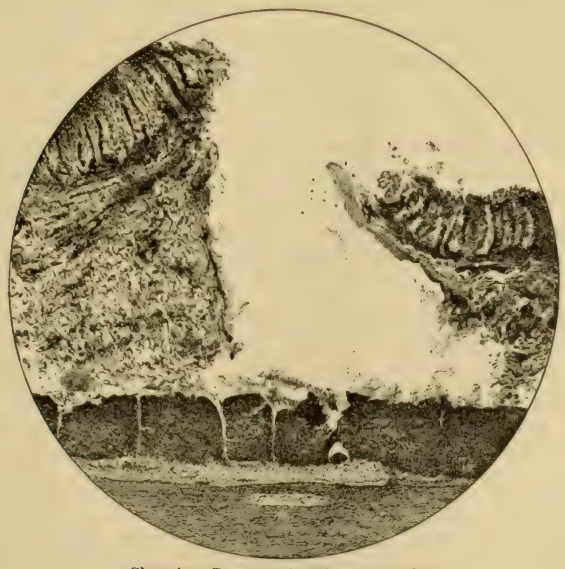
The following reports of necropsies illustrate some of the principal macroscopic lesions of dysentery:

Child, aged fourteen months, great emaciation, muscles flabby, and rigor mortis deficient. *Lungs.*—Hypostatic congestion of lower lobes. *Heart.*—Large ante-mortem clot in right auricle, and a smaller one in left auricle. *Glands.*—Mesenteric glands enlarged and congested. *Intestines.*—Patches of congestion in lower part of small intestine. Large intestine much thickened and deeply congested throughout its course. A few superficial ulcers, especially near the ileo-cæcal valve.

Busey's case. Necropsy twenty-four hours after death. Aged two years, emaciated, abdominal walls retracted, and rigidity slight. *Brain.*—Weight 2 pounds 5¼ ounces, anæmic, effusion into arachnoid cavity (estimated) 1 pint, slight in ventricles. Black clots in all the sinuses, and a large white fibrinous thrombus at the junction of the right lateral with the petrosal sinus. *Heart.*—Weight 1¼ ounces; effusion into pericardium; white fibrinous clot in superior vena cava extending into right auricle and firmly attached to base of tricuspid valve. No blood in either ventricle, and valves intact. *Lungs.*—Weight 7½ ounces, float in water; left normal, right contained in middle lobe a cheesy mass as large as a hen's egg; this lobe was firmly attached to pleura. No tubercular deposits. A cheesy bronchial gland as large as a pigeon's egg. *Abdomen.*—Abdominal walls thin and destitute of fat. Omentum contains but little fat. Mesenteric glands slightly enlarged and congested. Small intestines contain fæces, and nothing abnormal noted. Patches of intense inflammation all along the tract of large intestine from cæcum to anus. Liver anæmic, buff-colored; gall-bladder distended. Large deposits of pus at lower extremity of either kidney. Weight 1¼ ounces each.

Microscopical Appearances.—There is considerable loss of surface epithelium and of that lining the tubular glands. The glands frequently contain

Fig. 1.



Showing Dysenteric Ulcer of Colon.

pus-cells and degenerated epithelium. The interglandular tissue is infiltrated

with serum and pus-cells. The mucous membrane softens, and necrosis extends for a considerable distance into it. Here the glands are broken down, their confines are lost and they may fall out or remain incarcerated in cast-off epithelium, mucus, and pus. There may be ulceration accompanying these changes. The ulcers are shallow and without well-defined borders. They result from softening, suppuration, and exfoliation of the tissues into the submucosa or even down to the muscular coat. The solitary follicles are swollen to the size of two or three millimetres in diameter, and vary in color from transparent gray to opaque white. The swelling is due to an increase of round-cells or hyperplasia of lymphatic tissue. Large epithelial and pus-cells, mingled with lymphocytes, may be seen in the nodules. If the destructive process continue, the epithelium over the lymph-nodules breaks down and an ulcer is formed. The lymph-nodules then appear elevated, with a central depression.

Symptoms.—The onset may be sudden, without premonitory symptoms, accompanied by one or more chills or preceded by diarrhœa. The temperature is usually elevated two or three degrees, depending upon the intensity of the inflammation; the pulse soon becomes rapid, small, and compressible; the strength is rapidly diminished; and the face presents a pinched, pallid, and anxious expression. The tongue is moist and covered with a whitish fur. There is seldom abdominal pain or tenderness on pressure. There is constant desire to go to stool, with pain and straining during and after evacuation. The stools, which at first contain fæcal matter, soon become small, frequent, odorless, and consist of blood, mucus, and pus. Sloughs are rarely seen. The stools vary in number from eight or ten to forty or fifty in the twenty-four hours. As the inflammatory process advances to ulceration the stools contain shreds, resembling "washed raw meat," mingled with blood and pus, and may be passed involuntarily. The straining now becomes more severe, and prolapse of the rectum frequently results from it. The abdomen becomes tympanitic, and tenderness marked along the entire course of the colon. The tongue becomes dry, with brown centre and red margin. Vomiting may supervene, and prove to be intractable. The pulse becomes rapid, thready, and intermittent, and syncope threatening. The respirations become sighing and the voice inaudible. The eyelids are partially closed, and the pupils are widely dilated. The child becomes restless, and tosses from one side of the bed to the other, and delirium or convulsions may be present. The urine is high-colored and scanty, or there may be total suppression, with vesical tenesmus.

If examined microscopically, the typical "dysenteric stool" contains traces of ingesta, various kinds of bacteria, fat, epithelial cells, round cells, mucus, blood-corpuscles, and pus-corpuscles mingled together.

Cases. Nellie E——, aged eighteen months, had been suffering several days with loose bowels. The evacuations becoming frequent, small, bloody, and slimy, the parents called in a physician. He found that she had a dozen or more dysenteric stools daily, accompanied by great tenesmus, and that there was marked prostration. The disease yielded to treatment, and she recovered in three days.

John B——, aged twenty-two months, had had frequent bloody discharges for several days, and had been dosed with numerous remedies for "summer complaint" which had been prescribed by other physicians for other people's children. As he rapidly grew worse, I was summoned. Found him running about the room, but he would frequently assume the squatting position and strain. He had had twenty bloody, slimy, offensive stools, and as many of "a stain of blood and slime," during the previous twenty-four hours. The pain did not seem to be so severe, but he would strain until drenched with perspiration. He could not be kept in bed. Finally, his symptoms became so much worse that he was held by one of his parents, but not in recumbency. This modified rest did but little good, as the rectum was soon prolapsed to about half an inch. After

exhausting the usual methods of treatment the disease succumbed to suppositories of cocaine and ergotin, on the eighth day of my service.

Lottie E——, aged four years, was seen forty hours after the dysenteric symptoms began. She was now having frequent, offensive, muco-sanguinolent stools, accompanied by exhausting tenesmus. The pulse was frequent and small, and the temperature was not 100° F. The symptoms rapidly grew worse and she seemed liable to die at any moment from cardiac failure. The rectum protruded, became œdematous, and blood exuded from the mucous membrane. The prolapsed gut seemed to be about two inches in length. On the ninth day of the disease the dysentery yielded to treatment, but the prolapse lasted for a week longer.

Dimple G——, aged seven years, had been sick for five days with dysentery. The bloody discharges had increased in number, the pain had become more intense, the desire to stool more imperative, and the evacuations were characterized as small, bloody, and slimy. She was suffering from strangury produced by turpentine stupes, which had been used for several days. She had had two hundred and eighty-one bloody, slimy stools in thirty-six hours (four hundred and sixty-three during the five days of her illness). Dr. D. obtained this history, and the following day called me in consultation. She now had the appearance of being extremely ill. Her pulse was small, frequent, and compressible; the eyes were sunken and the pupils dilated; the cheeks were pale and sunken, and the lips livid and pinched; the tongue was slightly coated and very dry, and thirst was intense; there was nausea, but not vomiting, although she had vomited in the early part of the illness; the abdominal walls were flabby, and there was no pain upon pressure over the abdomen. She had not slept for several days, and was continually begging for sleep. The discharges were involuntary and had become so frequent that cloths were kept under the nates to catch them; they were small, bloody, and offensive. There was great pain and straining. The voice was almost inaudible, and the respiration was sighing. Cerebral anæmia was well marked. She had frequent attacks of syncope, although not permitted to raise her head from the pillow. Her condition was so critical that a physician remained in her room. Stimulants and food were systematically given until the stomach and rectum refused to retain them, when brandy and, finally, ether were given hypodermatically. The attacks of syncope became more and more frequent, and she died of exhaustion and heart failure seventy-two hours after the first consultation.

Diagnosis.—In sporadic cases of dysentery there may be some difficulty in differentiating it in its early stage from acute intestinal catarrh, but when the characteristic stools have once made their appearance all doubt will disappear. In dysentery the stools contain mucus, blood, pus, and small masses of fæcal matter, and are odorless or have a "fresh-meat odor;" tenesmus is always present, a small quantity is expelled from the bowel after a violent effort, and the patient is bathed in a cold, clammy sweat, is exhausted, and probably faints. In acute intestinal catarrh the evacuations are larger; the blood, when present, is in streaks and not mixed with mucus; the pain is more intense and paroxysmal; and tenesmus is seldom present.

The differentiation of sporadic from epidemic dysentery can be made by the prevalence of the latter in the community.

Prognosis.—The prognosis in acute catarrhal dysentery in children is usually favorable. The ordinary duration is from eight to ten days, but it may prove fatal in twelve, twenty-four, forty-eight, or seventy-two hours. The favorable symptoms are absence of foul odor, diminution in frequency and improvement in the character of the stools, and disappearance of tormina and tenesmus; the absence of nervous depression and of anxious and careworn expression of countenance; and increase of heart-power and arterial tension.

The unfavorable symptoms are increased blood-loss, ashy aspect of countenance, nausea, vomiting, hiccough, tympanitic and tender abdomen, nervous depression, sleeplessness, tossing about the bed, moaning, delirium, convulsions or other marked cerebral disturbances, and suppression of urine. When convulsions appear, death is not far distant. Busey observes that in many cases death takes place under exactly similar circumstances—viz., one, two, or

three convulsions, followed by coma and death, and in none of his cases did consciousness return after the first convulsion.

II. Amœbic Dysentery.[1]

This form, which is also known as tropical dysentery, is characterized by the presence in the stools of the *amœba coli* (Lösch), *amœba dysenteriæ* (Councilman and Lafleur). It is this form which occurs in such fatal epidemics in the tropics. "The amœba is a unicellular, protoplasmic, motile organism, from ten to twenty micro-millimetres in diameter, consisting of a clear outer zone, ectosarc, and a granular inner zone, endosarc, containing a nucleus and one or more vacuoles. It was first described by Lambl in 1859, and subsequently by Lösch, who considered it the cause of the disease"—(Osler). The disease is not infrequently seen in Europe and North America, but its home is in tropical and subtropical countries. The most frequent source of infection is unquestionably the drinking-water.

Morbid Anatomy.—Like the other varieties, the lesions are situated in the colon, but in some cases they are also found in the lower portion of the ileum. These lesions consist in ulcers, which result from infiltration into the submucosa. At first small elevations appear along the mucosa; the mucous membrane covering them sloughs off, exposing an ulcer with a grayish-yellow floor. Councilman divides these ulcers into four forms: (1) "Ulcers characterized by cellular infiltration, softening, and cavity-formation in the submucosa; these have a small opening in the mucous membrane and often communicate with neighboring ulcers by passages in the submucosa. (2) Ulcers with slight undermining of the edges, representing simple excavations in the thickened submucous tissue. (3) Ulcers with smooth sides and clean bases. (4) Ulcers with extensive adhering sloughs." These simply represent different stages of the same process. The non-adjacent mucosa remains unaffected.

Osler says the "microscopical examination shows a notable absence of the products of purulent inflammation. In the infiltrated tissues polynuclear leucocytes are seldom found, and never constitute purulent collections. On the other hand, there is proliferation of the fixed connective-tissue cells. Amœbæ are found more or less abundantly in the tissues at the base of, and around, the ulcers, in the lymphatic spaces, and occasionally in the blood-vessels.

"The lesions in the liver are of two kinds: firstly, local necroses of the parenchyma, scattered throughout the liver and possibly due to the action of chemical products of the amœbæ; and, secondly, abscesses. These may be single or multiple. When single they are generally in the right lobe, either toward the convex surface near its diaphragmatic attachment or on the concave surface in proximity to the bowel. Multiple abscesses are small and generally superficial. In an early stage the abscesses are grayish-yellow, with sharply defined contours, and contain a spongy necrotic material, with more or less fluid in its interstices. The larger abscesses have ragged, necrotic walls, and contain a more or less viscid, greenish-yellow or reddish-yellow purulent material mixed with blood and shreds of liver-tissue. The older abscesses have fibrous walls of a dense, almost cartilaginous toughness. A section of the abscess-wall shows an inner necrotic zone, a middle zone in which there is great proliferation of the connective-tissue cells and compression and atrophy

[1] The writer has depended almost entirely upon the valuable contributions of L. Emmett Holt, Osler, and Lafleur and Councilman in preparing the sections on amœbic and diphtheritic dysentery.

of the liver-cells, and an outer zone of intense hyperæmia. There is the same absence of purulent inflammation as in the intestine, except in those cases in which a secondary infection with pyogenic organisms has taken place. The material from the abscess-cavity shows chiefly fatty and granular detritus, few cellular elements, and more or less numerous amœbæ. Amœbæ are also found in the abscess-walls, chiefly in the inner necrotic zone. Cultures are usually sterile. Lesions in the lungs are seen when an abscess of the liver—as so frequently happens—points toward the diaphragm and extends by continuity through it into the lower lobe of the right lung. The gross and microscopical appearances are similar to those of the liver."

Symptoms.—Sometimes the onset is sudden and at other times gradual. The severer forms are characterized by a sudden onset. The diarrhœa intermits, while loss of strength and emaciation are progressive. Moderate fever is usually present, although some cases are unattended by this symptom. In some, tormina and tenesmus and nausea and vomiting are marked at the onset, while in others they are not observed. Twelve or fourteen grayish-yellow stools, containing blood and mucus are voided daily. This condition persists for weeks. The amœbæ are found in great numbers in the stools during the diarrhœal attacks, but gradually decrease, and finally disappear as the attack subsides.

Diagnosis.—This form is differentiated from the catarrhal by the frequent exaggeration and remission of the diarrhœal symptoms, but more especially by the presence of amœbæ in the stools.

Prognosis.—The duration varies from six to twelve weeks. The prognosis is not as favorable as in the catarrhal form; and convalescence is slow, owing to the depletion, the relapses, and the chronic tendency.

III.—Diphtheritic Dysentery.

Diphtheritic or croupous inflammation of the intestinal tract is the most fatal variety. It usually begins in the intestine, but may result from diphtheria situated in the mouth, pharynx, or nose.

Morbid Anatomy.—Macroscopically, there is nothing significant in the appearance of the intestinal contents unless patches of pseudo-membrane are found upon washing. The stools vary in color from yellowish-green to greenish-brown, and consist of mucus, fæcal matter, occasionally digested blood—seldom pure blood—and perhaps pieces of pseudo-membrane.

The lesions are situated over the entire colon and the lower portion of the ileum, but are most numerous near the cæcum. The intestinal wall is greatly thickened and the rugæ are obliterated. Small grayish-white, opaque masses are seen upon the congested mucosa. These masses cling to the surface, and can only be removed by tearing off a portion of the mucous membrane. These small areas may coalesce and form a patch which involves the greater part of the intestine, converting it into a thick, inflexible tube. Where the membrane is extensive it is marked by numerous transverse and longitudinal fissures, which give it the appearance of separate patches. The mucous membrane devoid of the patch is intensely congested and roughened, or the only changes may be confined to the diphtheritic areas.

Microscopical Appearances.—There is infiltration of the mucosa, and in some cases, of the submucosa. The pseudo-membrane is composed of fibrin, necrotic cells, and sometimes blood-corpuscles. The tubular glands are usually unrecognizable, but their remains may often be detected in the necrotic masses. The thickening of the intestine is due to the infiltration of the submucosa, the

dense mass of fibrin, the engorged blood-vessels, and extravasations of red blood-corpuscles. Ulcers are seldom present in children, but when found are usually of the follicular variety.

Symptoms.—This form is not seen in infants and is uncommon in children. In some cases the onset is insidious, and may be mistaken for the catarrhal, while in others it is abrupt and alarming. The symptoms are similar to, but more severe than, those of the catarrhal or amœbic. The pathognomonic symptom is the presence of pseudo-membrane in the stools.

Treatment of Dysentery.

Prophylaxis.—Acute catarrhal dysentery may often be avoided by promptly and energetically treating the simpler forms of intestinal disease. It too often happens that disorders of digestion are regarded as trifling, and skilled assistance is only summoned when the signs of severe anatomical lesions become manifest.

Hygiene.—Personal and domiciliary hygiene should be carefully supervised. The child should be bathed at least once a day, and in very hot weather twice. His clothing should be changed sufficiently often to protect him from sudden variations in temperature; especially is this true during the cool nights of autumn. If not already too ill, he should be removed from the heat of the city to some salubrious resort in the mountains or at the seashore. If circumstances compel him to remain at home, he should be placed in a room where pure, fresh air will be admitted freely. An occasional sponge-bath of equal parts of alcohol or bay-rum and water will prove to be grateful, and will reduce the body heat as well as allay nervous irritability. The infant's diapers should be removed and placed in a disinfecting solution as soon as soiled, and in older children the evacuations should be immediately disinfected. For this purpose solutions of carbolic acid, 1 : 20, corrosive sublimate, 1 : 500, milk of lime, or some other germicidal drug must be kept in some convenient place.

It is none the less important that the hygiene of the premises should be scrupulously watched and every means possible used to prevent the accumulation of filth.

Rest.—Rest in the recumbent posture must be enjoined from the start. The stools should be passed in this posture, as any other will increase the pain and straining.

Dietetic.—The diet should be prescribed in the very beginning, and but little discretion given to parent or nurse. The nursing infant should continue at the breast unless some condition of the mother, or of her milk, contraindicates it. In all others sterilized, Pasteurized, or peptonized milk, beef-tea, beef-juice, or mutton-broth, or all alternately, should be given in small quantities at frequent intervals. Care should be taken not to overfeed, lest harm be done. When the blood and mucus have disappeared from the stools, we may gradually but cautiously return to a more liberal and mixed diet. A liberal supply of natural mineral water, distilled water, or boiled city water must be allowed. If the child refuse or is unable to swallow, food must be administered by *gavage*—a method not at all difficult, and attended with satisfactory results.

Medicinal.—There are no specifics for this disease, although different remedies have been specially recommended by different writers. Some believe the best results are to be obtained from ipecacuanha, others from opium, purgatives, or vegetable or mineral astringents, while, latterly, many rely upon the administration of intestinal antiseptics, as salol, mercuric chloride, naph-

thol, and sulphocarbolate of zinc. While it may be admitted that all of these methods have their advantages in individual cases, still, no one has proved to be uniformly successful in the hands of those who treat the greatest number of cases.

Usually the first indication for treatment is the removal of undigested or indigestible food from the alimentary tract. For this purpose the mild saline purgatives are especially indicated, or a stronger purgative, as for a child aged 6 years:

℞. Pulv. ipecac. . . . . gr. ss.
Mass. hydrarg. . . . . gr. iij.
Pulv. aromatic. comp. . . . . gr. v.
Sacchar. alb. . . . . gr. xv.—M.
Ft. chart. No. X.
Sig. One every two hours.

℞. Tinct. opii deodorat. . . . . gtt. xij.
Olei ricini . . . . . f℥ss.
Pulv. acaciæ . . . . . q. s.
Aquæ rosæ . . . . . q. s. ad f℥ij.—M.
Sig. Tablespoonful every two hours.

As soon as the scybala and undigested masses have been removed this treatment should be suspended.

Of the mineral astringents the subnitrate of bismuth, in large doses, holds the highest rank. The author has, at times, received benefit from the following, which is both astringent and antiseptic:

℞. Plumbi acetatis . . . . . gr. iv.
Acidi acetic. . . . . q. s.
Acidi carbolic. . . . . gr. ij.
Liquor. calcis . . . . . q. s. ad f℥ij.
Mix the first, third, and fourth, and add enough of the second to make a perfectly clear solution.
Sig. Teaspoonful every three hours.

If the pain and straining are intense, relief may be derived from the following:

℞. Cocain. muriat. . . . . gr. j.
Ext. ergot. aq. . . . . gr. x.
Ext. opii aq. . . . . gr. ij.
Aristol . . . . . gr. v.
Olei theobrom. . . . . q. s.—M.
Ft. Suppos. No. X.
Sig. One every two or three hours.

Stimulants are imperative, but should be administered with great care. The dose of whiskey or brandy must be regulated by the age of the child and the exigencies of the case. When these fail, the more powerful and diffusible cardiac stimulants should be given, perhaps hypodermatically.

Local.—In the light of modern science the most rational treatment of dysentery is intestinal irrigation. By it the irritating contents of the colon and rectum are washed out and the pain and straining are mitigated, and in

some cases entirely relieved. A distinction has been drawn by Dr. W. W. Johnston, of Washington, D. C., between intestinal irrigation and injection. The former is more correctly the application of a running stream to the inflamed gut, in which the fluid has free egress, while in the latter the fluid is introduced to painful distention. In the former a second tube permits a free outpouring and in the latter the fluid must escape between the nozzle of the syringe and the anal sphincter or be forcibly expelled by the disabled intestine after the tube is withdrawn. The former is preferable when the lesions are below the sigmoid flexure, and the latter when they are above it.

To irrigate the rectum a double injection-tube, attached to a fountain syringe, should be passed from three to five inches into the bowel, through which a current of water is kept flowing at the pleasure of the operator. As the passing of such an instrument is nearly always attended with great pain, it is better to use two soft rubber catheters, well oiled; the larger is attached to the tube of the syringe, while the smaller is used as the escape-pipe. Pressure on the flexible tubes by the operator's fingers will regulate the inflow and outflow of the fluid.

To irrigate the entire colon in a child of eight or ten years it is necessary to inject one or two pints immediately after a stool, but an infant requires much less. The author has never succeeded in injecting such large quantities into the bowel, but has obtained very satisfactory results from small quantities by forcing it to be retained for a short time, by pressing a napkin against the anus. This fluid must be slowly injected, so as to allow the inflamed and infiltrated coats to adapt themselves to the increased tension.

The irrigating apparatus being ready, the child is placed on his left side, with the hips on a plane higher than the body, or, still better, in the knee-chest posture, so as to favor the inflow. The first irrigation should be given by the physician, who will thus instruct the nurse to follow his particular method. When the pain and tenesmus are severe, and the introduction of the tube intensifies both, the rectum may be partially or completely anæsthetized by suppositories of ice, aristol, europhen, or cocaine, or by the injection of a 2 or 4 per cent. solution of cocaine or carbolic acid.

The frequency of irrigation is best determined by the number of stools, the object being to prevent the patient from having stools by washing out the intestinal contents through the tube. At first the irrigation should be given after every stool; then, as the pain and tenesmus lessen and the blood and mucus decrease, it must be given at longer intervals; and, finally, when the movements border on the natural, a daily irrigation for a few days may prevent a relapse.

Hot or cold water, either plain or holding in solution one of the numerous antiseptics, may be used as the irrigating fluid. In some cases very hot water will afford marked benefit, while a large number, in the author's experience, have received almost immediate relief from cold or ice-water. The temperature of the water must be gradually lowered when irrigating the infant's bowel, as the shock from ice-water might prove fatal.

Every writer has a favorite antiseptic for dysentery, but mercuric chloride, 1:10,000, is most extensively employed. The bowel must be quickly and thoroughly emptied of this fluid to insure protection against its poisonous effects from absorption. Some of the other antiseptics are carbolic acid, boracic acid, hydrochloric acid, salicylic acid, aseptol, thymol, sulphocarbolate of zinc, nitrate of silver, alum, quinine, and creolin. While it is advisable to use some antiseptic solution in the graver forms, the great benefit to be derived from irrigation in catarrhal dysentery is the cleansing.

In amœbic dysentery, Councilman and Lafleur have used solutions of quinine, 1:5000, 1:2500, 1:1000, in five cases. In 3 cases improvement was marked, in 1 the injections were suspended owing to a fatal complication, and in the other the amœbæ did not decrease during the quinine injections. Lösch found by experimentation that solutions of quinine, 1:5000, would kill amœbæ outside of the body, so Councilman and Lafleur were led to use it by intestinal irrigation. The patient should be placed in the knee-chest posture, and a half-pint or a pint of the quinine solution injected thrice daily, the enema being retained for fifteen minutes. These writers claim that the enemata kill the amœbæ in the intestine, but have little or no effect upon those in the tissues.

In diphtheritic dysentery the same rules of treatment that are recommended in the other forms are applicable, but must be more vigorously employed. Irrigation with solutions of mercuric chloride, silver nitrate, or hydrogen peroxide seems to be the most rational procedure.

CHRONIC CONSTIPATION.

By J. HENRY FRUITNIGHT, A. M., M. D.,

New York.

Chronic Constipation, or the absence of a regular, periodical expulsion of fæcal excrement from the bowels, is very prevalent in infancy and early childhood. In childhood a daily evacuation should be the rule, whilst in infancy two, three, and sometimes even four, motions are usual.

Excluding acute bronchitis, habitual constipation is the most common ailment met with in early life. It is rather an aberration from the normal functional activity of the bowels than an essential disease, but if not relieved may in time seriously affect the general health of the patient by interfering with the functions of other organs and with the processes of nutrition, and, as an ultimate result, life even may be endangered. It often proves a very intractable disorder, and, despite all that is done, it may continue throughout the period of childhood, interfering with healthy development as well as with comfort. Children who are artificially fed are more prone to constipation than those who are suckled at the breast.

Etiology.—The cause of the constipation may exist in the person of the patient, or the condition may be the result of some extraneous influence. We will first speak of the former.

In the child the small intestine is comparatively longer and its lumen narrower than in the adult, and its walls are feeble and not so thick. Again, the ascending and the transverse colon are shorter, while the descending colon is longer relatively than in the adult. Finally, the many curves of the intestinal canal, the deep cul-de-sac in the sigmoid flexure just above the rectum, and the contracted conformation of the pelvis in children, with the consequent crowding of the intestines into a relatively small space, are well known. All of these anatomical peculiarities act as causal factors. Another element of importance in infancy, but which lessens in force as the child develops, is feeble peristalsis, due to the imperfectly-developed state of the muscular coat of the intestines.

A diminution in the amount of intestinal secretions, especially of the bile, favors the occurrence of constipation, for under such conditions the fæcal mass becomes hard and scybalous, and is apt to be too long retained. Then, too, if fermentable food be taken, large quantities of flatus are generated and pain and abdominal distention attend the constipation.

Certain pathological conditions, obstructive in nature, are often present. Among such conditions are tumors, congenital malformations, and uterine retroflexions; constricting bands resulting from acute or chronic peritonitis; intestinal displacements, stenosis at the ileo-cæcal valve, and a nest of lumbricoid worms. Local disorders seated in the rectum may also cause constipation. Chief among these is fissure of the anus, for in this disease, as pain is produced when defecation is attempted, the patient refrains from the act of evacuation and the constipated habit is gradually formed.

In diseases of the central nervous system, as tubercular meningitis, hydrocephalus, microcephalus, and myelitis, which interfere with the innervation of the abdominal and intestinal structures or which produce a spastic contraction of these parts, constipation is generally present. The various constitutional dyscrasiæ, as tuberculosis, rachitis, syphilis, and the like, may, by weakening the muscles engaged in the act of defecation, act as causes.

Any condition depriving the organism of water in large quantities renders the fæces dry and predisposes to sluggish bowels: profuse perspiration and the polyuria of diabetes come under this head. Want of attention in infancy and the neglect to respond to the calls of nature on the part of older children are potent factors, for by repeated stimulation and over-distention of the rectum by its contents, its muscular activity is worn out and an atonic condition is the result. Constipation sometimes results from diarrhœa. In such cases it is due to atony and paresis of the muscular envelope of the intestines caused by excessive and persistent irritation. Insufficient peristalsis, accumulation of fæces, dilatation of the entire bowel or of certain parts, accompanied by reflex symptoms due to interference with other functions of the body, are additional factors conducing to this result. Some authors say that all cases of habitual constipation are accompanied by a considerable amount of chronic irritation and subacute inflammation of the cæcum and colon and neighboring cellular tissue. The effect of this is to reflexly arrest peristalsis.

We will now consider what may be called the *extrinsic causes* of constipation, or those which operate from without the body. Constipation in infants at the breast may be the consequence of a constipated habit on the part of the mother. In such cases the maternal milk may be deficient in fat, sugar, or salt. In older children improper food is a very frequent cause. On the one hand, food may be given to the child which after digestion leaves very little residue in the bowel, so that no stimulation of the intestines is produced for the expulsion of its contents. On the other, too coarse foods may be given, and the residue may be so great that by constant over-stimulation of the muscular coats of the intestines their tonicity is exhausted. Excess of farinaceous foods will act in this manner, and all foods that are prone to fermentation by producing accumulations of gas will hinder free action of the bowels. Lack of moisture in the intestinal contents, resulting from scanty ingestion of water, is another factor; and still more potent are the indiscriminate use of medicinal agents, especially castor oil and spiced syrup of rhubarb—laxatives having a secondary astringent action—and the repeated use of enemata, which destroy the natural sensibility and reflex activity of the rectum.

In older children an in-door, sedentary life, negligence in regard to the formation of a regular habit of evacuating the bowel, and a faulty posture at stool are active in producing the constipated habit. In regard to the last element, it may be said that in the physiological act of defecation the individual should assume such an attitude that every muscle of the back and abdomen which causes the bowel to be quickly and thoroughly emptied of its contents may be brought into action.

Pathology.—The pathological condition to be found in constipation varies from a simple hyperæmia to a catarrhal or even ulcerative condition of the mucous membrane of the intestines. Yet in many cases nothing whatever is to be discovered in the intestinal canal. The intestinal walls are apt to become thin, and some authors maintain that fatty degeneration of the muscular coat of the intestines supervenes, resulting in a loss of contractility and expulsive power. A swollen and distended condition of the bowels and a chronic inflammation, with induration and thickening in the region of the cæcum, are occa-

sionally met with. Herniæ, particularly umbilical, prolapsus ani, varicocele, fissure, cystitis, and hæmorrhoids may be the results of the violent and oft-repeated straining, and the liver may be pressed upward and congested from interference with the portal circulation.

Symptoms.—When constipation is due to obstruction, fæcal matter accumulates above the occluded point and produces distention of the abdomen, accompanied by eructations of gas, vomiting, impaired appetite, and a consequent deterioration of the general health. If the intestinal contents be composed of hard masses or contain coarse, undigested material, there is danger of complete obstruction which will place the patient in a very perilous position.

In mild cases of functional constipation there is simply a retention of the fæces in the rectum or lower bowel; then there are no marked symptoms with the exception of a sensation of fulness, distention, and weight in these parts.

Generally speaking, the symptoms vary in degree according to the gradation from the mild to the very grave forms of the disorder, but it is surprising how frequently even severe cases of constipation are unattended by serious symptoms. Very often, in consequence of local irritation from the retained fæces, a conservative purging is excited, and the patient suffers alternately from diarrhœa and constipation. The bowel, however, is not always fully emptied of its contents when such a diarrhœa occurs, and the retained fæces in time undergo decomposition, with the generation of noxious gases, which in turn distend and irritate the bowels and cause severe colic. Fæcal and gaseous distention also interferes with the action of the diaphragm, and produces labored respiration or even great dyspnœa; it may also obstruct the venous circulation in the viscera and interfere with the cardiac action and the circulation in the thoracic cavity, leading to palpitation of the heart, irregular pulse, and vertigo. Again, pressure upon the abdominal and portal venous systems hinders the return circulation from the lower extremities, and produces slight œdema of the ankles and feet; finally, obstruction of the portal ducts and vessels, with attendant resorption of bile, may give rise to jaundice. In aggravated cases of chronic constipation the pressure of the retained fæces may cause inflammation of the mucous lining of the gut, when abdominal tenderness and fever will be noted. Sometimes the inflammation extends to ulceration, or even perforation, with their attendant symptoms.

When a constipated patient attempts to evacuate his bowels, he will experience great tenesmus, and the expelled mass may be streaked with blood and smeared with mucus, indicating that the lining membrane of the rectum has suffered in the violent effort at expulsion.

In infants constipation is accompanied by fretfulness; the little patient draws up his legs in pain, and, if he be nervously irritable, is very prone to an attack of eclampsia.

In all cases of long-standing retention the fluid elements of the fæces are reabsorbed, to be eliminated from the body by other emunctories. When this occurs the blood becomes contaminated, and there is impairment of the general health, with the production of such symptoms as languor, a foul breath and furred tongue, headache, nausea, and more or less complete anorexia; irritability of temper or hypochondriasis and moroseness. The abdominal nervous plexuses also are affected, and the sufferer, when old enough, complains of formication, fatigue, and pain in the abdomen and lower extremities.

Diagnosis.—While the recognition of the existence of constipation is of course very easy, it is often a difficult problem to detect the condition—the actual disease—leading to the functional disorder of the bowels; and this

problem must be correctly solved before successful treatment can be inaugurated.

Such conditions as hernia, hæmorrhoids, and continued tenesmus should always lead one to expect the presence of the constipated habit. On the other hand, all children who have small or infrequent fæcal evacuations are not constipated, as such features may be noticed when the food is too concentrated or is allowed in insufficient quantity.

Prognosis.—Simple idiopathic chronic constipation never endangers life. If, however, the condition depends upon some structural abnormality, the prognosis is more grave. In its consequences, both immediate and remote, constipation is of serious import. It will lead, as has been said, to fissures, hæmorrhoids, and other local troubles; it impairs the general health, and if not attended to early a lifelong habit is formed.

Treatment.—To secure, if possible, the removal of its cause should be our first consideration in the treatment of constipation. If, on account of structural or pathological reasons, this be impossible, our efforts must be directed to the minimization of its ill effects. In nurslings drugs should, as far as possible, be avoided, attention being paid to the food and to the diet of the mother or nurse. If the mother's milk be deficient in fat, sugar, or salts, her diet should be so modified that a larger quantity of these principles are presented for assimilation; she should also partake of laxative foods. If the child be nourished by a wet-nurse, the same ends may be accomplished by a change to one who is in an earlier stage of lactation and whose milk contains more fat and less albumin. When, in spite of these measures, the constipation continues, some simple laxative is indicated. I frequently use a little molasses or melted sugar and butter or sweet oil in teaspoonful doses. If the constipation be due to an insufficiency of fluids, as indicated by dry and brittle motions, it is wise to insist upon the child's being given water several times daily—an item often overlooked by parents and nurses. Sometimes oatmeal-water may be substituted for plain water with advantage, particularly in older children taking a mixed diet.

When these simple measures fail, the next resort is to suppositories or enemata, which act by local stimulation of the rectal muscles. Suppositories should be conical in shape and made either of soap or molasses candy, or should contain either gluten or glycerin. I prefer those containing glycerin, as being most prompt and efficient in action. But whatever variety is selected, it should be well oiled before insertion, and then gently introduced and pushed up well beyond the internal sphincter. Glycerin may also be used by injection, in the proportion of ten to twenty drops to two fluidrachms of water. Such an injection is followed in from five to ten minutes by a full and painless motion. The efficiency of the glycerin is due to its hygroscopic action; it abstracts water from the mucous membrane of the rectum, inducing hyperæmia of the part and increasing peristaltic action through nervous excitation. Cold-water injections are also recommended. These may be given at first three times, then twice, and finally once, daily until a cure is effected. The addition of a little table salt increases the activity of these enemas. As to the bulk of the injection, one or two fluidrachms will usually suffice in infants. Too large enemata not only dilate the bowel and paralyze its muscular coats, but may also give rise to much pain, and even interfere with the respiration and circulation.

If it be necessary to resort to drugs, the most simple are to be chosen, as small doses of calomel, castor oil, solution of citrate of magnesium, carbonate of magnesium, and phosphate of sodium, in properly graded doses. The last

remedy has given me great satisfaction in doses of one to five grains according to the age of the patient. I frequently administer it in the following combination:

℞. Sodii phosphatis . . . . . gr. xxiv.
Syr. mannæ . . . . . f℥iiss.
Aq. anisi . . . . . q.s. ad f℥iij.—M.
Sig. One teaspoonful three times daily, for a child under one year old.

Calomel may be given in one-sixth grain doses several times daily, but must not be employed habitually; laxatives that can be used more freely are carbonate of magnesium in one- or two-grain doses in a little milk or aromatic water, and the solution of the citrate of magnesium in doses of one to four fluid drachms.

Older children must be trained to the formation of the habit of regular daily evacuation of the bowels at a fixed time. Neglect of this very important rule is very often the cause of constipation persisting through adult life, with its disagreeable train of symptoms. Attention should also be directed to the posture assumed in the act of defecation, in order that all the necessary muscles may be brought into play. It is important, too, at this age to encourage outdoor exercise, and to so regulate the diet that the child will receive plenty of water and an abundance of laxative food. In this class belong fruit, either in its natural state or cooked, oatmeal or cracked-wheat porridge, corn and brown bread, green vegetables, molasses, etc. Farinaceous foods must be restricted, but milk may be taken freely if the digestion be good. In the proscribed list come cheese, uncooked dried fruits, fruits having numbers of small seeds, and spices.

In the administration of medicine select the particular one that agrees best with the patient; seek the appropriate dose to secure an evacuation; then gradually reduce the dose until the constipation is ended. One of the most useful drugs is calomel, given alone or in combination with powdered rhubarb, half a grain of the former to one grain of the latter. This may be repeated several times daily, but care must be taken not to administer calomel repeatedly in either tuberculous or rachitic children. If any rectal irritation be present, compound licorice powder combined with sulphur is very useful. If flatus be present, carbonate of magnesium combined with asafœtida will afford relief. The fluid extract of cascara sagrada in one- or two-drop doses is a very good remedy. Dr. Earle of Chicago recommends "in the case of a child two years of age to clean out the bowels with two or three grains of calomel combined with a little compound licorice powder, followed for a few days with carbonate of magnesium ʒij in f℥j of water, one to three teaspoonfuls daily until the bowels are relaxed. Then give non-astringent iron preparations, nux vomica, and possibly magnesium sulphate or cascara, until the cure is complete."

It has also been suggested that small doses of ipecacuanha, either alone or combined with calomel, are very useful.

When there is great distention of the bowels it will be of advantage to bandage the abdomen in order to assist in the restoration of muscle-tone. The colon may be punctured with a hypodermatic needle when its distention is so great that collapse is imminent from heart displacement. When there are large collections of fæcal matter in the colon, the more active cathartics must be exhibited, accompanied by irrigation of the bowel through a rectal tube. If the fæces are very hard, it is advisable to add to the fluid injected inspissated ox-gall in the proportion of ʒij to the pint. I frequently add to the ox-gall

the following mixture, which stimulates the bowel to relieve itself of its contents, and also helps to carry off flatus:

℞. Ol. terebinthinæ . . . . . f℥j.
Tr. asafœtidæ, ...
Ol. ricini . . . . . āā f℥iv.—M.
Sig. Add to a quart of warm water, and use for irrigation.

The suds of ordinary brown washing soap may also be added to this mixture. If the rectum be impacted, instrumental and manual assistance must be given; injections of small quantities of yeast have been also used with success. Gradual dilatation of the sphincter has also been successfully employed. If constipation be accompanied by the symptoms of indigestion, the diet should be revised; pepsin with muriatic acid and cascara or taraxacum should be prescribed. I again desire to call attention to the phosphate of sodium; in older children it may be given in doses of from five to eight grains dissolved in water.

The constipation which succeeds a diarrhœa requires the use of tonics. Of these, strychnine stands first in efficacy, administered either alone or in the favorite combination of iron, quinine, and strychnine. When atony of the muscular coat occasions the trouble, nux vomica combined with belladonna, ergot, and phosphorus are very valuable remedies.

As each case must be treated on its own merits, many of the cathartic remedies which have not been alluded to by name will undoubtedly meet special indications in special cases. Thus when there is an interference with the hepatic functions the following is an excellent prescription:

℞. Resinæ podophylli . . . . . gr. j.
Alcohol . . . . . f℥iss.
Syr. rubi idæi . . . . . q. s. ad f℥iij.—M.
Sig. A teaspoonful to a dessertspoonful every morning, according to the obstinacy of the constipation.

When a copious evacuation is desirable the following is recommended:

℞. Tr. nucis vomicæ . . . . . ♏xij.
Tr. belladonnæ . . . . . ♏xxiv.
Inf. sennæ . . . . . f℥j.
Inf. calumbæ . . . . . q. s. ad f℥iij.—M.
Sig. One teaspoonful for a dose.

The constipation which attends the various diathetic conditions demands individual attention, but by no means to the exclusion of the diathesis itself. Cod-liver oil and the syrup of the iodide of iron, both somewhat laxative in nature, are especially useful in these cases. A very good formula is that prescribed by Dr. J. Lewis Smith:

℞. Olei morrhuæ . . . . . f℥ij.
Liquor. calcis,
Syr. calcii lactophosphatis . . . . āā f℥j.—M.
Sig. Give from one-quarter to one teaspoonful three times daily, according to age of child.

For anæmic children mineral waters containing iron are beneficial. Thus Friedrichshall is serviceable, as it has a tonic and laxative effect, and also

favors the elimination of uric acid. In such cases a mixture of sulphate of magnesium, sulphate of iron, and tincture of nux vomica is also serviceable.

Galvanism has its use in the treatment of constipation. The negative pole is passed well up into the rectum, and the positive along the course of the colon over the abdomen, for the negative pole excites local contraction, and the positive pole peristalsis. Galvanism is to be preferred to faradism, being more efficacious.

In conclusion, attention must be directed to one of the most important measures used in the treatment of chronic constipation—namely, massage of the abdomen and its contents. The technique of massage in children, though it differs in no essential particular from the same procedure in adults, should be modified in conformity with the position of the digestive organs at the various periods of the child's life. As the main cause of constipation in children, exclusive of the weak muscular coat of the bowel, resides in the descending colon, it is rarely necessary to practise the manipulations on the right side of the abdomen. The application of massage for as short a time as three minutes has been known to produce the desired effect, and the sitting should not last more than ten minutes. It may be repeated two or three times a day. The method of application is as follows: The operation is preferable before nursing or feeding, excepting when the child is very fretful or when the abdominal walls become very tense on handling. In such cases it can be accomplished during the act of feeding, for when the walls are very tense nothing can be effected. The hands should be clean, warm, and dry. The resistance and rigidity of the muscles will determine the amount of pressure to be used. The production of pain should be avoided; hence the pressure should be gradually made, and until the child becomes accustomed to it the manipulation should be very gentle. The finger-tips placed upon the skin of the abdomen are moved about with the skin over the intestines, but *not rubbed.* For the first two or three minutes concentric circles are described by the manipulation in the region of the umbilicus; then in a similar manner the descending colon is treated, more pressure being made in the downward than in the upward movement. More manipulation is required in the left iliac fossa than elsewhere, for obvious reasons. The cæcum and ascending colon may at times also require to be manipulated in the same way. In older children sudden tapping of the abdominal walls with the finger-tips, which will excite an instantaneous contraction of the abdominal muscles, has been found to be of value. The results obtained by massage have been very gratifying, and it should always be added to whatever other treatment may be instituted at any period of infancy or childhood.

SIMPLE ATROPHY.

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Simple Atrophy, or the slow wasting commonly termed "marasmus," is a familiar occurrence in hand-fed babies, and one of the most frequent causes of death in early infancy. It is a condition in which there is extreme wasting of the soft tissues of the body, either without special organic lesions or with catarrhal inflammation of the mucous membrane of the gastro-intestinal canal.

Etiology.—Wasting usually occurs during the first twelve months of life, though it may begin in the second year, and is most frequently encountered among children of the poor. It arises both in breast-fed babies and in those brought up by hand, being in either case due to insufficient nourishment. The child wastes because he is starved.

Food can be insufficient in two ways: first, when it is supplied in amounts too limited to meet the demands of the system; and second, when it contains a minimum of the elements essential to nutrition or presents them in a form ill adapted to the feeble digestive powers of infancy. For example, nursing infants waste in consequence of feeding either from a breast that yields too little good milk, or from one that secretes abundantly a poor, watery fluid entirely unfit for nourishment. With artificially-fed children, on the other hand, it rarely happens that the quantity of food is too small; the fault lies, rather, in the direction of quality. Undiluted cows' milk, milk thickened with starchy materials, farinaceous foods, and even table food—meat, vegetables, and bread—are given to babies a few weeks or months old. Now, all of these are highly nutritious, but the digestive apparatus is not sufficiently developed to prepare them for absorption. They are strong foods, adapted to nourish and strengthen much older children and adults, but as the infant cannot appropriate them, he starves no less surely, if more slowly, than when taking no food at all. Such aliment also, while remaining undigested in the stomach and intestines, undergoes fermentation, with the formation of irritant products, causing vomiting or diarrhœa—conditions that still further lower the vital powers and hasten atrophy.

It is often possible to trace the disease directly to want of cleanliness in the feeding apparatus, and especially to the use of a form of bottle that has until lately been very popular in this country, as it is still in England. This bottle has, in place of a plain gum tip, an arrangement of glass and rubber tubing of small calibre. One extremity of the rubber tubing, which is eight or nine inches long, terminates in a small nipple-shaped tip and bone shield; the other, after penetrating an ornamental rubber cork, is fitted to a bit of glass tubing long enough to extend quite to the bottom of the bottle. By this plan the trouble of holding the bottle and keeping it at a proper angle during feeding is avoided. This seeming advantage, though, is counterbalanced both by the minor drawback that the child, left to itself, is apt to continue suction long

after the bottle is exhausted, thus swallowing a quantity of air, and by the greater disadvantage that the tubing can never be kept clean.

For a number of years the author made it a rule to ask for the bottle of every hand-fed infant presented for treatment, and few days passed without his seeing several of the complicated contrivances referred to. In almost every instance, notwithstanding the most careful and frequent cleansing, a sour odor could be detected, and if milk were present it contained numerous small curds; while in cases of carelessness the odor was intolerable, and the interior of the tubing was encrusted with a layer of altered curd. With simple bottles and tips, on the contrary, alterations in the character of the milk and coating of the interior of the tips were very infrequent. As there is little difficulty in keeping the bottles themselves clean, there can be only one reason for this difference—namely, in the simple instrument the nipple is readily removed and as easily inverted and cleaned, but in the other there is no way of cleaning thoroughly the twelve or more inches of fine tubing. The latter cannot be inverted, and the passage of a stream of water or of a stiff brush only imperfectly removes the milk clinging to the interior. This, of course, soon undergoes decomposition, and in this state quickly inaugurates change in the next supply of milk placed in the bottle. It is evident that a constant supply of food, no matter how good originally, thus rendered acid and partially curdled, must, like an excess of farinaceous or other unsuitable food, produce irritation of the alimentary canal, interfere with the processes of nutrition, and lead to a state in which the features of wasting and disordered digestion are combined.

The custom of preparing in the morning, without sterilizing, a supply of food sufficient for the whole day is another fruitful cause of atrophy. If this be done, no matter how carefully the mixture be proportioned or how well adapted to the age and digestion of the child, it becomes unfit for consumption after standing eight or ten hours. The change may or may not be appreciable to the senses, but test-paper will always show acidity and the microscope demonstrate the existence of actively-moving bacteria. Again, food upon which a child has thrived for three or four months, perhaps, can become unsuitable, and consequently lead to wasting, if the digestive powers be suddenly reduced by an intercurrent disease.

Wasting, while it is less serious in babies suckled at the breast, frequently occurs in a modified form under these circumstances. There are several additional causal factors. Thus, an infant may be given to a wet-nurse whose own baby is much older than her foster-child. In this case the milk is too strong, for it is a well-known fact that as lactation advances human milk becomes proportionately richer in curd and cream, and the nursling, unable to digest and assimilate it, ceases to thrive, and may even, in consequence, suffer from indigestion or diarrhœa. Human milk is also affected by dietetic and emotional influences, and, altering with the state of the general health of the mother, may deteriorate in quality or otherwise become unfit for food. Finally, it happens at times that, although the mother may be healthy and have an abundant breast, and although the infant may be robust, yet it does not thrive on the milk supplied. Here the fault is generally an over-richness in cream. While noting these facts, it must be remembered that in many cases of wasting in nursing infants the fault is not with the mother's milk, but in the digestive organs of the child, an attack of catarrh having temporarily impaired the process of digestion. Without care and proper management the derangement may be prolonged, and not infrequently leads to unnecessary weaning.

Morbid Anatomy.—After death the muscular and other tissues are found

in a state of atrophy, and there is a total disappearance of normal fat from the body. Fatty degeneration of the kidneys, lungs, and brain may be discovered; the stomach is sometimes ulcerated, and hæmorrhagic effusions into the cranium are not uncommon.

Symptoms.—The clinical features differ materially according to whether the element of insufficiency be one of quantity or quality. They may, therefore, be divided into two classes—viz. those developed by food that is suitable but not sufficient, and those resulting from unsuitable food.

The first group of symptoms is most frequently encountered in children who have been nursed at the breasts of feeble or overworked mothers, in whom the milk is often both scanty and of poor quality. There is a gradual loss of plumpness, the muscles grow flaccid, and there seems to be an arrest of growth. The face is white, the lips pale and thin, the skin harsh and dry or too moist, and the anterior fontanelle level or slightly depressed. The temper is irritable and sleep restless and disturbed; or the child is abnormally quiet, dozing constantly, and sucking his fingers until they become raw. When nursed the child seizes the nipple ravenously; then, if there be little milk, he quickly drops it to cry passionately, as if disappointed at not being able to satisfy his hunger; but if the milk be abundant, though thin, he will lie a long time quietly at the breast, and often fall asleep with the nipple in his mouth. The bowels are inclined to constipation, the stools being scanty, hard, and dry. Physical signs connected with the chest and abdomen are negative, and no indication of disease of any special organ of the body can be detected.

In the second class, features of wasting are associated with those of irritation of the alimentary canal, and the symptoms altogether are much more grave than in cases of the preceding group. The subjects are almost invariably hand-fed infants. Emaciation progresses with a rapidity and to an extent depending upon the original strength of the child's constitution, the age at which artificial feeding was begun, and the sort of food employed. It is often so extreme that an infant several months old weighs less and appears smaller than at birth, and this even after a large quantity of food, such as it is, has been consumed. The combination of great wasting with a voracious appetite is very striking, and is only apparently contradictory, since hunger—the demand of the tissues for reparative material—cannot be appeased by food which, from its bad quality, is incapable of digestion or proper preparation for absorption and assimilation. Unsuitable food, too, by irritating the mucous membrane of the stomach, creates a fictitious appetite.

Sooner or later the face becomes pinched, the eyes sunken; the lips are pale, and when moved display a deep furrow about the angles of the mouth; the facial expression is uneasy or languid, and the anterior fontanelle is deeply depressed. The skin, generally, is dry, harsh, and yellowish, hangs in loose folds over the bones, and may be mottled by an eruption of strophulus or urticaria, or present red patches of intertrigo in the neighborhood of the genitalia and over the buttocks and inner surface of the thighs. The extremities are cold and the hands claw-like. The tongue is heavily furred or red and dry, and with the mucous membrane of the mouth may be the seat of aphthous ulceration or thrush deposit. As already stated, the appetite is often ravenous, and the cries of hunger are violent, oft repeated, and only temporarily silenced by food; thirst is increased; colic is common; the bowels are constipated, and the stools, which are voided with difficulty and straining, are composed of a few light-colored, cheesy lumps partly covered with greenish mucus.

Attacks of acute vomiting and diarrhœa often interrupt the regular course of the disease. At such times there is moderate fever during the night, though

ordinarily the temperature is subnormal. Again, chronic vomiting and chronic diarrhœa are apt to arise as complications, and greatly increase the danger of a fatal termination.

Sleep is restless and disturbed, and many hours, particularly during the night, are spent in fretful crying. A common group of symptoms connected with the nervous system is "inward spasms." When these occur the upper lip becomes livid, somewhat everted, and tremulous; the eyeballs rotate or there is a slight squint, and the fingers and toes are strongly flexed. They frequently usher in true convulsions.

Sometimes the nervous manifestations are much more complex. Thus, I have seen cases where there was retraction of the head, boring of the head into the pillow, an approximation to the "gun-hammer" decubitus, general hyperæsthesia, and the tache cérébrale,—all suggestive of tubercular meningitis. Such symptoms disappear under an appropriate diet with proper medicinal treatment, and are to be referred to an intensely excitable nervous system—a condition depending upon insufficient nourishment, and differing merely in degree from that leading to "inward spasms."

There is, of course, extreme prostration, the cardiac action is weak, and the respiration shallow. The urine is citron-colored or very dark yellow, has a specific gravity of 1009 to 1012.5, a strong, characteristic odor, and is diminished in quantity. It is always cloudy or milky, only becoming clear on the approach of recovery. The sediment deposited on standing contains variously-shaped cylinders; fatty elements with tinted nuclei; mucus; colored uric acid; urates in a crystallized or amorphous condition; pigment, etc. The reaction is sometimes highly acid. The proportion of urates is decidedly, that of uric acid notably, and of coloring matter and extractives somewhat, increased. Albumin is always present in variable quantity, and sugar also may be frequently detected.

Death may be preceded by convulsions or the symptoms of spurious hydrocephalus, or may result from prostration.

Diagnosis.—Great emaciation may result from inherited syphilis or acute tuberculosis, but both of these conditions are attended by characteristic symptoms, rendering their diagnosis a matter of little difficulty. In inherited syphilis the child snuffles and cries hoarsely. The skin is dry, wrinkled, old-parchment-colored, and mottled with coppery or rust-colored spots. Often the buttocks, perineum, genitalia, and upper portion of the thighs are the color of the lean of ham. Mucous patches are present at the margin of the anus and of the lips. The corners of the mouth are fissured, the nostrils red and excoriated, and the bridge of the nose is flattened. Enlargement of the spleen can frequently be detected on abdominal palpation.

In acute tuberculosis there is fever, the rectal temperature reaching 100° to 101° F. in the evening; cough with irregularly distributed bronchial râles, and usually slight œdema of the legs.

When symptoms resembling those of tubercular meningitis are present, it is often necessary to delay a definite opinion. In simple atrophy, however, the open fontanelle is level or depressed; the belly is never scaphoid; the bowels, though frequently constipated, are never locked; vomiting is apt to be associated with diarrhœa; the respiration and pulse are regular in rhythm; the temperature, as a rule, is subnormal; there is no hydrencephalic cry; and the antecedent history and the course are different from the tubercular disease.

Prognosis.—A vast number of cases die annually in our large cities, yet the results of appropriate management are often rapidly and surprisingly



CASE OF SIMPLE ATROPHY, æt. three months.

Weight at birth, 4 lbs.; weight on admission to Children's Hospital, 3½ lbs. Fed on a mixture of cane-sugar and water. (Died twelve hours after admission to hospital.)

successful. Patients should never be given up unless there be extreme wasting and prostration, or unless the symptoms of spurious hydrocephalus arise, convulsions occur, or obstinate chronic vomiting or diarrhœa be developed.

Treatment.—For the arrest of wasting from insufficient nourishment, the first and main thing to be attended to is the diet. Without entering at length into this subject,[1] it may be stated, as a uniform rule, that in selecting a diet the object should be to fix upon one suited to the age and digestive powers of the child, so that he may be able to digest, and, therefore, be nourished by, all the food consumed.

Generally, infants under twelve months who have to be either partially or entirely "brought up by hand" do well upon cows' milk, diluted with lime-water or with barley-water. Often it is well to sterilize the milk, or—a method which has been most uniformly successful in my hands—to add to the milk mixture peptogenic milk powder, and subject to a temperature of 155° F. for six minutes. The food should be administered from a bottle capable of holding half a pint, made of colorless glass, so that the least particle of dirt can be seen, and provided with a soft India-rubber tip. Unless sterilized or Pasteurized, the whole quantity of food intended to be given in a day should never be prepared at once, but each portion must be made separately at the time of administration. Thus, a bottle of the sort described, absolutely clean, may be filled with a mixture of one part of lime-water to two or three of sound milk, or with one part of barley-water to two or three of milk, to either of which may be added from one to two tablespoonfuls of cream and a teaspoonful of pure sugar of milk. The bottle must next be placed in hot water until the contents become warm, when it is ready for the child.

The degree of dilution of the milk and the proportion of cream added vary with the age and feebleness of digestion, but it is upon the latter that we must chiefly base the composition of the food. Lime-water is the preferable diluent when there is frequent vomiting or acid eructation. Both it and barley-water are of service in preventing the formation of large, compact curds—an object that is even better accomplished by peptogenic milk powder, and by the process of partial predigestion. In some cases it may be necessary to discontinue milk foods entirely, putting the child temporarily upon weak broths or raw beef juice.

After digestion has been brought into good condition, the food may be cautiously increased to a standard suitable for a healthy child of the same age. At eight or ten months from two to four fluidounces of thin mutton or chicken broth, free from grease, may be allowed each day in addition to the milk; at twelve months, the yolk of a soft-boiled egg, rice and milk, and carefully mashed potatoes moistened with gravy; and at the end of the second year, a small quantity of finely-minced meat.

Once daily the patient should be bathed in warm water, or at least sponged over with warm water, and every morning and evening a teaspoonful of warm olive oil or of cod-liver oil should be rubbed into the skin over the abdomen and chest. At the same time the belly must be completely covered with a soft flannel binder, and the feet and surface generally kept warm by woollen clothing. In this way attacks of colic, if not entirely prevented, are rendered much less frequent and severe.

If there be intertrigo, cleanliness and the free use of oxide-of-zinc ointment usually suffice to effect a cure.

Of medicines, bicarbonate of sodium, pepsin, pancreatin, nux vomica, and cod-liver oil are perhaps the most useful. Cod-liver oil should not be given

[1] For the details of diet and general management, see Introduction.

until the digestive powers have been brought into a comparatively normal state by proper food, antacids, and digestants and the general tone increased by tincture of nux vomica. The oil is most easily borne when given in emulsion, and may be advantageously combined with lactophosphate of lime or with the hypophosphites.

Such symptoms as constipation, diarrhœa, and vomiting demand, of course, appropriate treatment.

DISEASES OF THE CÆCUM AND APPENDIX.

By JOHN ASHHURST, Jr., M. D.,

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Inflammatory Affections of the Cæcum and Appendix.

Under the names of typhlitis, perityphlitis, appendicitis, cæcitis, perityphlitic abscess, etc. are included by systematic writers certain cases of inflammation, usually severe and sometimes ending in suppuration or in general peritonitis, met with in the right ilio-lumbar region. While these cases are met with at all ages, they are sufficiently common in children to make their consideration proper in a work devoted to the maladies of childhood, and they are so often attended with danger and lead to such serious consequences that their importance can hardly be overestimated.

The terms *typhlitis* and *cæcitis* are strictly applicable to inflammation, catarrhal or parenchymatous, affecting the cæcum (blind gut) or caput coli; *perityphlitis* to an inflammation of the areolar or connective tissue behind the cæcum, where this portion of bowel is usually uncovered by peritoneum; *perityphlitic abscess* to a collection of pus occurring in the same region; and the somewhat barbarous term *appendicitis* to an inflammation of the pouch or diverticulum known as the appendix vermiformis. Without denying that the caput coli itself may be primarily the seat of inflammation, as indeed may any portion of the intestines, constituting the grave condition *enteritis*, and while acknowledging at least the possibility of a true perityphlitis, perhaps leading to extra-peritoneal suppuration, there can, I think, be no doubt that in the large majority of instances the appendix vermiformis is the part primarily involved, and that the resulting abscess, when pus is formed, is intra-peritoneally situated, though fortunately, in most cases, walled off by adhesions which prevent the general infection of the peritoneal cavity.

Morbid Anatomy.—The pathological lesions found in cases of inflammation of the cæcum and appendix are quite variable. In the majority of cases the inflammation does not advance beyond the stage of lymph-formation, and even after repeated attacks (for the disease is often recurrent) the parts will be found indurated and thickened, and matted together by dense adhesions; but there will be no abscess. In other instances, and particularly when the patient is tuberculous, pus will form at an early period, usually as the result of ulceration and perforation of the intestinal wall, but sometimes without perforation, simply from the intensity of the inflammation. Foreign bodies, such as grape-seeds, etc., are occasionally found lodged in the cæcum or appendix, or loose in the surrounding abscess; but more commonly what are supposed to be foreign bodies are really concretions of earthy phosphates with fæcal matter and inspissated mucus, or of inspissated mucus alone. The cæcum from its shape and position is apt to become the lodging-place for concretions of this character, which set up irritation and may lead to ulceration of the cæcal wall, while small

concretions may enter the appendix, or, as is more commonly the case, the mouth of the appendix becoming occluded by catarrhal inflammation and thickening, concretions form *in situ* by inspissation of the retained secretion of the part, which in the normal condition is poured into the cæcum, and forms a natural lubricant for the fæcal mass in its passage through the large intestine. When pus forms in these cases, it may make its way into an adjoining segment of bowel; may become more or less thoroughly encysted and form a fluctuating tumor in the iliac fossa; may burrow in various directions, coming to the surface in the lumbar region above the iliac crest, or, passing downward in the course of the psoas muscle, below Poupart's ligament; or, finally, may infect the general cavity of the peritoneum, causing diffuse purulent peritonitis, which quickly proves fatal. In exceptional cases the pus has been known to perforate the diaphragm, causing pleurisy and empyema, or to enter the hip-joint.

Etiology.—The causes of typhlitis and appendicitis may be divided into the *predisposing* and the *exciting causes*. Among the former may be mentioned *sex*, these affections being much more common in the male than in the female, in the proportion, it is said, of six to one; *age*, most cases occurring in early life; the presence of *tubercle*, tuberculous patients being not only more exposed to appendicitis than the non-tuberculous, but the disease in them more quickly running on to suppuration, and convalescence after an operation, should such be necessary, being effected more slowly and with more interruptions; and *habitual constipation*, the retention of fæcal matter in the cæcum, which is sometimes distended to an enormous size, maintaining a constant source of irritation, and exposing the intestinal wall to the dangers of ulceration and perforation. The *exciting causes* are the entrance of foreign bodies into the appendix—seeds, pins, hairs, etc.; the ingestion of indigestible food; exposure to cold or wet; falls, blows, or strains of the abdominal parietes; and the abuse of drastic purgatives.

Symptoms.—The symptoms of typhlitis and appendicitis are variable and often deceptive. Sometimes beginning with a *chill*, the early symptoms are more often those of enteritis generally, pain, vomiting and constipation, fever, and tenderness with some fulness in the region of the inflamed part. The *pain* is usually greatest in the right iliac fossa, but is sometimes referred to the navel, and may even be most marked on the left side of the abdomen; but even when the pain is misplaced, the greatest *tenderness* will, unless general peritonitis be impending, be found upon the right side, and especially at a point distant an inch or an inch and a half (in the adult two inches) from the anterior superior spinous process of the ilium, and in a line drawn from that point to the umbilicus. This tender spot, which is known as "McBurney's point," corresponds to the position of the appendix, and, as already mentioned, it is the appendix which is primarily involved in the large majority of cases. At a later period, when pus has formed, the "soft spot" which precedes pointing of the abscess may sometimes be detected in precisely the same locality. Coincidently with the development of tenderness in the right iliac region, gentle palpation will reveal a *fulness*, followed at a later stage by tenderness and tumefaction, in the position of the cæcum; and in order to relieve the inflamed part from pressure of the superjacent tissues, the patient will usually secure relaxation of the abdominal wall by lying on his back, slightly turning to the right side, and with the right knee drawn up.

The *vomiting* is often distressing, attended with considerable effort, and aggravates the pain by succussion of the inflamed parts: the ejected matters consist at first of the contents of the stomach, and afterward of the intestinal juices with bile; fæcal vomiting does not, as a rule, occur, even when general

peritonitis follows, this being a point of some importance in the diagnosis of these conditions from intussusception and other forms of mechanical obstruction of the bowel. The *constipation* in appendicitis and typhlitis is not complete: there may be an occasional discharge of flatus; evacuations may be secured by the use of enemata, and the administration of salines may cause even free catharsis without modifying the other symptoms of the disease. The *fever* is not very intense, the temperature varying from 101° to 102° F., and is accompanied with a quick pulse, furred tongue, and intense thirst: when suppuration occurs the fever may assume a hectic type, and in the cases which terminate unfavorably the tongue becomes brown and dry, sordes accumulate about the lips and teeth, and the patient passes into a decidedly "typhoid" condition.

When *suppuration* occurs the symptoms undergo some modification. The pain and tenderness are usually increased; rigors may occur at irregular intervals; the tumefaction in the right iliac region becomes somewhat boggy, the overlying integument being perhaps congested and slightly œdematous; a "soft spot" may be observed; and, if the pus be not evacuated, fluctuation, with ultimately pointing, as in abscesses elsewhere. There are sometimes pain in the right knee and ankle, and œdema of the leg. The pus in these cases commonly has a strong fæcal odor from proximity to the bowel, even though no perforation be discoverable.

Diagnosis.—The diagnosis of appendicitis and typhlitis can usually be made without difficulty if the symptoms be carefully noted, the affections in regard to which confusion is most likely to occur being enteritis, intestinal obstruction, psoas and iliac abscess, and hip disease. *Enteritis*—by which term is meant inflammation involving all the coats of a segment of intestine—is well described by Sir Thomas Watson as "peritonitis with something more." It may occur in any part of the bowel, not being limited to the right iliac region, and the localizing symptoms of appendicitis—McBurney's point, etc.—are therefore wanting. The paralysis of the gut is more complete, constipation consequently being more absolute, with no discharge of flatus, and the vomiting, if relief be not afforded, soon assuming a fæcal character. Typhlitis, using the term accurately, is of course a form of enteritis, but when the inflammation is limited to the cæcum the symptoms are less severe than when a larger portion of bowel is implicated. *Mechanical obstruction* of the intestine in children is usually of the character of *intussusception*, though *internal strangulation* by bands or diverticula is occasionally met with. In the latter condition the pain would be felt mainly at the seat of obstruction or more commonly at the umbilicus; there would be no fever, the temperature more probably being subnormal, sometimes even after the development of peritonitis; there would be fæcal vomiting, with absolute constipation and inability to pass wind; general tympany, from paralysis of the bowel allowing gaseous distention; partial suppression of urine; and the patient would pass into a state of collapse, sooner or later according to the position and closeness of the strangulation. In *intussusception* there might be fever from secondary inflammation of the affected bowel; there would be a tumor, but instead of occupying the right iliac fossa, it would be found in a median position or upon the left side; there would, in acute cases, be a discharge of blood and mucus from the bowel; and digital exploration of the rectum would, in children at least, probably detect the lower end of the invagination. *Psoas abscess* is usually, though not invariably, accompanied by evidences of preceding disease of the spinal column, is not attended by pain or marked tenderness, and presents no intestinal complications; *iliac abscess*, if depending upon ovarian or periuterine inflammation and

situated on the right side, may more closely simulate appendicitis; but even here the distinction may be made by observing the absence of bowel symptoms. In *hip disease* the peculiar and characteristic deformity and malposition of the limb, varying with the stage of the disease, will suffice, when present, to clear up the diagnosis; in appendicitis, though extension of the limb may cause great pain, it is not accompanied by the arching of the lumbar spine observed in hip disease, and the joint may be moved, without causing suffering, in other directions. In the rare cases in which an abscess, originating in appendicitis, opens into the hip-joint, causing secondary disease of that articulation, the symptoms would be confused, both maladies then, in fact, coexisting in the same subject; but under ordinary circumstances the absence of intestinal symptoms in the one case, and the absence of joint symptoms in the other, ought to prevent the possibility of error.

With regard to the special diagnostic importance of "McBurney's point," a good deal of difference of opinion prevails among practitioners, and the tendency at the present time is to consider it of but little value. For my own part, I am disposed to place considerable reliance upon this symptom, and believe that the detection of induration and tenderness, or at a later period of a "soft spot," in this particular situation is, while perhaps not pathognomonic, at least strongly significant of disease originating in the appendix.

Tumor of the kidney, perinephric abscess, carcinoma of the bowel, and abscess of the abdominal wall have been mistaken for appendicitis, but careful examination and investigation of the history of the case ought to prevent an error in this direction.

The diagnosis of perforation of the cæcum or appendix may be made when symptoms of suppuration occur, or when the spread of pain and tenderness to the left side of the abdomen indicates the threatened implication of the peritoneum generally. Fortunately, before or immediately after the occurrence of perforation, adhesions usually form and seal off the affected part from the rest of the peritoneal cavity, and even where this does not occur, an interval of some hours, or even a day or two, may intervene before the development of universal peritonitis, giving an opportunity for prompt surgical intervention which may save life even in this emergency.

Prognosis.—The prognosis in appendicitis and typhlitis is in the large majority of cases favorable. Under judicious treatment the acute symptoms will subside in from four days to a fortnight, although a certain amount of induration and tenderness may persist for a much longer period. The patient is now apt to become intolerant of the regimen and rest which has been hitherto enforced, and resumes his ordinary diet and manner of living, with the result that relapse occurs; and this sequence of events may be repeated indefinitely. The reason that recurrence of appendicitis is so often met with is, I believe, that the patients will not persist in treatment until completely recovered. If thoroughly cured, a second attack is not, according to my experience, to be particularly dreaded.

When perforation occurs the prognosis becomes more gloomy. In the rare cases, if such exist, in which the opening is in the cæcum behind the peritoneum, a burrowing abscess will result, and convalescence will, under the most favorable circumstances, be tedious. If the perforation be intra-peritoneal, peritonitis, local or general, is inevitable; in the former case, the infected area being separated by adhesions from the general cavity, recovery after operation may be hoped for; in the latter, though by prompt intervention a patient may occasionally be snatched, as it were, from the very jaws of death, yet the large majority will perish; diffuse suppurative peritonitis is almost always a fatal

affection. In tuberculous patients the prognosis, *cæteris paribus*, is always less favorable than in others.

Treatment.—The treatment of appendicitis and typhlitis may be either prophylactic or curative. As *preventive* measures, care should be taken to avoid constipation by regulation of the diet, by encouraging defecation at a fixed hour daily, and, if necessary, by the use of laxatives. The patient should be warmly clad, especially around the abdomen, should keep the feet dry, and should avoid exposure to cold and wet generally. When the disease actually occurs, the indications for *remedial* treatment are—(1) to keep the inflamed part at rest; (2) to relieve the congestion; (3) to prevent pain; and (4) to maintain the patient's nutrition without overtaxing the impaired powers of digestion. If suppuration occur, the pus must be promptly evacuated by incision and drainage. The first indication is met by keeping the patient in bed and by avoiding the use of purgatives, which under these circumstances can only do harm. The constipation and consequent accumulation of fæcal matter in these cases are owing to paralysis of the bowel, more or less complete, due to its inflamed state; or, in other words, are a *result*, not a *cause*, of the inflammation. This is a distinction which often the friends of the patient, and sometimes even the physician, seem unable to comprehend; they cannot understand that the patient is not ill because his bowels are not moved, but that his bowels are not moved because he is ill. In saying this I am not unmindful of the fact that salines, in small but frequently repeated doses, are often used in these cases, and that the patients sometimes do well under this treatment; but the benefit is due to the action of the remedy as an indirect means of effecting depletion and drainage, and if this could be accomplished without catharsis it would be so much the better. The second and third indications are met by the application of leeches (if the symptoms are very urgent), and by the use of warm cataplasms and the administration of opium. The fourth indication is met by careful feeding with peptonized milk or other liquid nutriment, or, if the patient vomit, by employing nutritive enemata. The course of treatment may then be established as follows: The patient being strictly confined to bed, a few leeches are applied over the seat of greatest pain, drawing from two to six fluidounces of blood according to his age; if for any reason leeching be thought unadvisable, a small blister may be applied, and the part afterward covered with mercurial and belladonna ointments, equal parts, spread upon lint, and over this in turn a warm flaxseed or elm poultice. Enough opium should be given to relieve pain, either by the mouth in the form of the deodorized tincture, or by suppository; or morphia may be given hypodermatically if preferred. Belladonna may properly be combined with the opium, and is also to be used locally with the mercurial ointment, as already described. When the pain has entirely ceased, but not before, if the bowels do not move spontaneously in the course of twenty-four hours, a warm enema of olive oil and soap-suds may be administered; if this fail, and if there be no tendency to vomiting, small doses of the Epsom or Rochelle salt—from half a drachm to a drachm—may be tentatively given every hour or two hours, the enema being repeated twice daily; if there is nausea or vomiting, the saline should be omitted, and calomel in minute doses (gr. $\frac{1}{20}$—$\frac{1}{12}$), with bicarbonate of sodium (gr. j-ij), may be given instead. Administered in this way, and the patient being still kept under the influence of opium, I doubt if these medicines cause any increase of peristalsis, and the good which they undoubtedly do is, as already mentioned, due to the serous flow from the congested and inflamed bowel to which they give rise.

After the subsidence of all acute symptoms the salines may be continued in

reduced doses, so as to cause two or three passages from the intestines daily, and the local use of mercury and belladonna, or a belladonna plaster, should be continued until the swelling and tenderness have disappeared, when the remaining induration may be treated by painting the part with tincture of iodine every day or every other day, according to the effect produced, maintaining mild but persistent counter-irritation without blistering. During the early stages the right lower limb may be flexed over a pillow to relax the abdominal wall, but as soon as possible it should be brought flat, and, if there is any tendency to permanent contraction, weight-extension should be applied to keep the limb in proper position.

In the large majority of cases, unless the patient be tuberculous, prompt and persistent treatment on the lines above indicated will suffice to effect recovery. After convalescence the patient should live by rule, avoiding indigestible food, and observing all the precautions referred to in speaking of prophylaxis.

If, however, instead of yielding to treatment, the symptoms persist, and the evidences of deep-seated suppuration—fluctuation, superficial œdema, or a "soft spot"—are manifested, no time should be lost in resorting to an exploratory operation. So important is promptness under these circumstances that it has been maintained that in every case the physician should associate with himself a surgeon to watch the patient from the beginning of the attack, so that there may be no delay when the critical moment arrives. I am not prepared to say that this is always necessary, but I do say that if a physician undertakes the management of a case of appendicitis alone, he should possess the *tactus eruditus* which will enable him to recognize suppuration as soon as it occurs. I have more than once been called to patients who had been treated many days, if not weeks, by practitioners who had not detected the presence of pus, the signs of which were yet, to the surgical sense, quite obvious.

Operations for Appendicitis.—It was formerly recommended, when suppuration was believed to have occurred in cases of cæcal or appendiceal inflammation, to verify the diagnosis by the introduction of an exploring needle; but the feeling of modern surgeons is against the use of this instrument, as being very apt, on the one hand, to miss striking the purulent collection, and, on the other hand, if it should reach the abscess, apt to infect the peritoneal cavity as it is withdrawn; and a careful incision of moderate extent is, I have no doubt, safer in every way than the blind thrust of a needle-point, as well as more likely to discover the seat of suppuration. Before making the incision the abdominal wall should be thoroughly cleansed and purified, but with great care and gentleness, as it would be quite possible for a vigorous antiseptic scrubbing to break through the limiting adhesions and diffuse the contents of an abscess through the peritoneal cavity. Operators differ as to the best line for incision: when it was believed that the purulent collection was formed outside of the peritoneum, the rule, as laid down by Willard Parker, Hancock, Buck, and Sands—who may be regarded as the pioneers in this branch of surgery—was to make the incision above Poupart's ligament, as in tying the external iliac artery, and endeavor to reach the abscess by cautiously working upward and pushing the serous membrane out of the way; but since it is now generally recognized that, as taught by Weir, the abscess is actually intra-peritoneal in origin, the marginal incision is no longer thought important, and surgeons aim to reach and evacuate the pus by the most direct route. If the case is so far advanced that fluctuation is manifest, the incision should be made where this is most perceptible; but under other circumstances the best position, I think, is in the general direc-

tion of the right linea semilunaris, taking care that a part of the wound shall be through the so-called "McBurney's point," which, as already mentioned, corresponds to the usual situation of the appendix. Some operators prefer to place the incision more laterally, believing that they thus secure better drainage, but, upon the whole, in most cases, I prefer the anterior position.

The first cut, about four inches in length, should pass through the skin and superficial fascia, and the deeper layers are then cautiously divided upon a director, all bleeding being checked before the abdominal cavity is opened. When the peritoneum is reached, it is cautiously raised with forceps and nicked by the edge, not the point, of the knife held sideways—as in the operation for strangulated hernia—the wound being then carefully enlarged with blunt-pointed scissors guided and guarded by the finger as a director. As soon as the cavity is opened a gush of pus will usually serve to confirm the diagnosis, but if this does not occur the surgeon should cautiously explore with his finger and a blunt director in the neighborhood of the cæcum until the seat of suppuration is discovered. After evacuation of the pus the cavity is carefully but thoroughly washed out with hot distilled water, and the surgeon then searches for the appendix, which, if found, should be removed. Often this can be done without difficulty, the organ, enlarged and thickened, being readily separated by the finger from its adhesions and brought out at the wound; its neck should then be tied with two strong carbolized silk ligatures, and divided between them. If, however, the appendix cannot readily be found, it is better to allow it to remain than unduly to prolong the operation by hunting for it, nothing being more deleterious in abdominal surgery than prolonged delay and unnecessary manipulation of the viscera.

After a final washing with hot distilled water, a full-sized drainage-tube, of glass or rubber, should be introduced, carried to the bottom of the cavity, and secured with a stout ligature or safety-pin. Some surgeons merely pack the wound with iodoform gauze, instead of introducing a tube, but my own preference is for the latter practice. As to the choice between glass and rubber, my rule is, when the abscess-cavity is completely walled off from the general peritoneal surface, to use a rubber tube, which is shortened from time to time as the wound heals; but when the peritoneal cavity is opened, I employ a glass tube, armed with a rubber-dam and containing a rope of absorbent cotton, which is renewed as often as it is saturated without disturbing the dressing applied to the rest of the wound, the tube being at the same time sucked out with a long-beaked syringe until the secretion becomes of a pale straw color, and is reduced to a minimum, when the tube is finally removed. A few sutures may be applied to the extremities of the wound, but it should not be tightly closed, being rather allowed to heal firmly by granulation and cicatrization.

There is little or no danger of consecutive hernia in this situation, and if there is any communication with the bowel, fæcal fistula will be less apt to follow in an open wound than in one which has united only superficially. Fæcal fistula, however, contrary to the doctrine formerly held, is really a rare complication after the operation for appendicitis, and is not to be dreaded unless some grave constitutional condition, such as general tuberculosis, interfere with the healing of the wound.

All surgeons are agreed as to the propriety of operative intervention in cases of acute appendicitis in which suppuration is believed to have occurred, but some go further, and enthusiastic operators advise that the appendix should be removed after recovery as a means of preventing recurrence of the disease. I have myself operated under these circumstances, and successfully, but I think

that there are very few cases in which such a course is justifiable. The time to perform an operation in itself dangerous—and opening the peritoneal cavity is dangerous, gynæcological and surgical enthusiasts to the contrary notwithstanding—is when a greater and imminent danger may be averted by so doing, and not when the patient is well; and when we consider that the very extensive statistics of the London Hospital show that 90 per cent. of all cases of appendicitis end in recovery without operation, we may well hesitate before submitting a patient to a mode of treatment equally needless and heroic. The only circumstances which seem to me to justify an operation after convalescence are when the patient has had repeated attacks at decreasing intervals and of increasing severity, and when he is going to be so placed that skilled surgical assistance will not be available in the event of further recurrence.

Non-inflammatory Affections.

The cæcum has occasionally been found in a hernial protrusion (*cæcal hernia*), as has the appendix, the latter particularly in the variety of rupture incorrectly called congenital, in which the bowel escapes into the patulous vaginal process of peritoneum. Cæcal hernia is often irreducible through the formation of adhesions between the portion of gut uncovered by peritoneum and the adjoining structures. The appendix, even when not itself diseased, sometimes acquires adhesions to other parts, and may then cause *internal strangulation*, a loop of bowel being caught beneath the appendix and constricted as if by a fibrous band. Should such a condition be discovered during an operation for intestinal obstruction, the appendix should be divided between two ligatures, or, which would be better, excised, so as to prevent the possibility of a recurrence. *Malignant growths* are met with in the cæcum, though not often in children, and may be treated on the same principles which guide the surgeon in dealing with similar affections in other portions of the bowel.

INTUSSUSCEPTION.

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INTUSSUSCEPTION, or invagination of the bowel, is by far the most frequent cause of mechanical obstruction of the intestine met with in childhood, though internal strangulation by an adherent appendix or by Meckel's diverticulum, or more rarely by a band of organized lymph left from a previous peritonitis, occasionally occurs. Invagination, as the name implies, consists in an ensheathing of one segment of bowel within another, the invaginated part being almost always from a higher portion (that is, farther from the anus) than that into which it is received. Thus, the jejunum is invaginated into the ileum, that into the cæcum and colon, etc. The much rarer condition, that in which the lower segment is received into the upper, is called *retrograde intussusception.* It is not uncommon for this affection to occur among the multiple invaginations which arise during the act of dying, but *direct intussusceptions* are those which are met with during life, and which call for treatment. Every complete intussusception involves three layers of bowel, and each layer consists of all the intestinal coats; the outer layer is the *sheath*, or *receiving layer*, the *intussuscipiens;* and the internal or *entering layer*, together with the middle or *returning layer*, constitutes the invaginated part, or *intussusceptum.* The *apex* of the intussusception is at the junction of the inner and middle layer—the lowest point, therefore, of the intussusceptum; while its neck is at the junction of the middle and external layers—the uppermost part of the intussuscipiens. *Double intussusceptions* are occasionally met with, five layers of gut being then involved, either a second intussusceptum having been forced into the first, which then constitutes its sheath, or the intussicipiens with its contained intussusceptum being in turn invaginated into a fresh portion of bowel, which then forms a second sheath. Still more rarely *triple intussusceptions*, involving seven layers of bowel, have been found.

Locality.—In rather more than one-half of all cases of intussusception the invagination occurs about the junction of the small and large intestines: usually the cæcum, and afterward the colon, is inverted, the ileum pushing before it the ileo-cæcal valve, which is thus found at the apex of the intussusceptum; much more rarely the ileum slips through the valve, which then constitutes the neck of the intussuscipiens, and the intussusceptum grows by successive invagination of fresh portions of small intestine. The former variety is known as *ileo-cæcal*, and the latter as *ileo-colic intussusception.* In somewhat less than one-third of the whole number of cases the invagination is limited to the small intestine (*ileal* or *jejunal intussusception*), and in the remainder, or about one-sixth, to the large intestine (*colic intussusception*).

Except in the ileo-colic variety, in which the neck remains fixed, an intussusception increases at the expense of its sheath, which becomes gradually inverted, the apex of the intussusception remaining constant while its neck is

continually changing; in the ileo-colic variety fresh portions of ileum keep passing through the valve, and the neck therefore remains unchanged while the apex varies. As the entering layer carries the mesentery with it into the sheath, a certain amount of traction is exerted upon one side of the intussusceptum, and as a result the intussusception becomes curved or even sharply flexed upon itself, and at the same time the apex becomes displaced toward the mesenteric side of the intussuscipiens, both of these conditions tending mechanically to render the occlusion of the gut more complete than it would be otherwise. The *extent of bowel* involved in an intussusception varies from a few inches to six or more feet.

Though an invagination usually begins on the right side of the abdomen, its increase, in the most common or ileo-cæcal variety, is mainly at the expense of the large intestine; and therefore by the time it has acquired sufficient size to be recognized by palpation the *tumor* will be chiefly on the *left* side, and eventually the ileo-cæcal valve with the apex of the intussusceptum may be protruded from the anus: even when this does not occur, the apex, in children at least, can very commonly be detected by digital exploration of the rectum.

Morbid Anatomy.—The adjacent serous layers in an intussusception soon become more or less closely united by adhesions, which, if firm, render the invagination *irreducible.* These adhesions may join the two layers of the intussusceptum to each other over a considerable space, or may be limited to the region of the neck; they are very seldom found exclusively at the apex. The sheath of the intussusception may become ulcerated from pressure, and even perforation may occur; but more commonly, beyond a certain amount of congestion and inflammation, no marked changes are found in this layer. The intussusceptum, on the other hand, is usually more or less completely strangulated, and becomes gangrenous, when, if there are firm adhesions at the neck, the dead portion may be separated and evacuated as a whole or in segments through the anus, the patient eventually recovering. Under other circumstances, the adhesions being defective, fæcal extravasation into the peritoneal cavity may occur, the death of the patient following; or the adhesions, while preventing death at the moment, may form the starting-point of a stricture, which in turn, at a later period, may cause fatal obstruction.

Post-mortem inspection in a case of intussusception reveals the elongated tumor caused by the invagination, usually on the left side of the abdomen, with an apparent absence of that portion of bowel which is invaginated. The outer layer or sheath of the intussusception is usually of a gray color, doughy in feel, and sometimes ulcerated from distention, while the intussusceptum, when exposed, is found of a deep-red color, resembling a clot of blood, or black and gangrenous. The intestine above the seat of obstruction is commonly much dilated, and filled with fæcal matter and gas, while that below is collapsed and shrunken, and is either empty or contains a small quantity of blood and mucus. There is sometimes general peritonitis.

Etiology.—Nothnagel has investigated experimentally the causes of intussusception, and describes a *paralytic* and a *spasmodic* variety, the latter being the more frequent. Differing from the ordinary doctrine, he believes that the invagination is caused by the normal gut being drawn over the spasmodically contracted part, rather than by that being mechanically driven into its sheath. Treves also adverts to the influence exercised by the longitudinal muscular fibres of the bowel, acting from the contracted part as from a fixed point, and thus drawing the uncontracted part over the other. Age and sex are usually spoken of as *predisposing causes* of invagination, the large majority of cases

occurring in male children; the great relative length of the colon in infancy, together with the width of the mesocolon, doubtless favors the displacement of the gut, and in some degree accounts for the frequency of intussusception in the early periods of life. Impaired general health, diarrhœa, the presence in the bowel of undigested or irritating food, polypoid growths, strictures and tumors of the intestine, and previously existing adhesions, are often predisposing causes of more or less importance. The *exciting cause* is increased and irregular peristaltic movement, no matter how produced.

Symptoms.—The chief symptoms of intussusception are pain, nausea and vomiting, tympanitic distention of the abdomen, fever, tenesmus, with discharge of blood and mucus by the rectum, the presence of a tumor (usually on the left side), and a corresponding depression or flattening on the right side. Abdominal *pain* is usually the first symptom manifested, occurring suddenly, of a very intense character, referred mainly to the umbilicus, the child writhing and drawing up its limbs in agony, and accompanied by vomiting of whatever may be in the stomach, and often by a liquid fæcal discharge, evacuating the contents of the bowel below the seat of obstruction. The pain is not constant at first, but occurs at irregular intervals, each paroxysm being commonly attended by a discharge of bloody mucus from the rectum, but as the case goes on the pain becomes continuous, though even then marked by exacerbations. The cause of the pain is at first the mechanical squeezing of the invaginated bowel by its sheath; afterward the increased peristalsis of the intestine above, endeavoring to force its contents through the part which is occluded; and finally, the extreme distention of the upper bowel and the inflamed condition of the intussusception itself and of its peritoneal covering. A sudden cessation of pain in the last stages indicates the occurrence of gangrene, which may be followed by discharge of the sphacelated portion and recovery, but is more often the immediate precursor of death. Abdominal *tenderness*, localized at the seat of invagination, is developed in connection with the pain as soon as inflammation of the affected portion of bowel has set in.

The *vomiting* in intussusception is a very prominent symptom, being present, according to Dr. Fitz's statistics, in 70 per cent. of all cases, but is, I think, less distressing, in the early stages at least, than in cases of internal strangulation. When secondary enteritis occurs the vomiting increases, but even then comparatively seldom assumes a fæcal character. The vomiting diminishes again with the approach of collapse.

Tympanites is not very marked in intussusception, being, according to Dr. Fitz, only present in the minority of cases. Indeed, there is often a marked depression in the right iliac fossa (*signe de Dance*) from the displacement of the cæcum toward the left side.

Fever is not present at the beginning of an intussusception, but is observed in connection with the occurrence of secondary enteritis, the thermometer rising to 102° or 103° F. This is of some importance in aiding the diagnosis between invagination and internal strangulation, the temperature in the latter condition sometimes remaining subnormal even after the development of general peritonitis. *Partial suppression of urine* often accompanies the fever in intussusception, and appears to depend more on the acuteness than on the locality of the disease.

Unlike other forms of intestinal obstruction, invagination is not necessarily accompanied by *constipation*, though in the acute variety, owing to the lateral displacement of the gut from traction of the mesentery and to secondary enteritis, fæcal discharges are absent. In chronic intussusception, however, there may be little interference with defecation, and in acute cases there is a

constant desire to go to stool (*tenesmus*), with frequent discharges of blood and mucus. This symptom Mr. Pollock considered to be almost pathognomonic.

The tumor is a very characteristic symptom of intussusception, and, as already mentioned, is usually found on the left side. In this it differs from the tumor of fæcal impaction, which is almost always found on the right side, and which may often be made to pit by deep pressure over its surface. The right side in intussusception is, as mentioned above, often depressed and flattened (Dance's sign), and the tumor is painful and tender to the touch. It can frequently be detected by introducing the finger into the rectum, and sometimes comes so low as to protrude from the anus.

Chronic intussusceptions are sometimes met with, and have been particularly studied by Rafinesque, who finds that 70 per cent. occur in the region of the ileo-cæcal valve (60 per cent. ileo-cæcal, 10 per cent. ileo-colic), and that the remainder are equally divided between the large and small intestine. The symptoms of chronic invagination are much less distinctive than those of the acute variety, the tumor changing its shape and locality from time to time, fæcal evacuations being often continued, diarrhœa sometimes alternating with constipation, and the pain and vomiting occurring at perhaps long intervals.

Diagnosis.—Intussusception has been confounded with simple colic, appendicitis, enteritis, dysentery, fæcal impaction, and other forms of mechanical obstruction. From *colic* it may be distinguished by the paroxysmal character of the pain, the vomiting, and the tenesmus, with discharge of bloody mucus. The detection of a tumor, either on the left side of the abdomen or by rectal exploration, would further demonstrate the nature of the affection. From *appendicitis* and consequent *suppurative peritonitis*, the diagnosis can be made by noting the symptoms just referred to, and by further observing that in those affections there are tympanites, tenderness, and fulness in the right iliac fossa (as contrasted with the depression in invagination), and an earlier development of fever. In *enteritis* there is also fever from the beginning, with constipation, but without bloody discharges and without any well-defined tumor. I have known the convexity of the lumbar vertebræ, as felt by abdominal palpation, to be mistaken for the tumor of intussusception, but the error could hardly be made except by carelessness. The tenesmus, pain, and evacuation of blood and mucus are the only points of resemblance between intussusception and *dysentery*, while the mode of attack and course of the several affections are entirely different. In *fæcal impaction* there is a tumor, but usually on the right side, and it can be indented by firm pressure, while the peculiar evacuations of invagination are wanting. The only form of *mechanical obstruction*, apart from intussusception, which is likely to be met with in children is *internal strangulation*, and in that condition the profound and early collapse, the low temperature, and the stercoraceous vomiting will clear up the diagnosis.

Prognosis.—The prognosis in cases of intussusception is always grave in the extreme, Leichtenstern's statistics showing a death-rate (in acute cases) of 73 per cent., and Fitz's smaller figures one of 69 per cent. The most favorable termination is in spontaneous reduction of the invagination, which can, as a rule, only be effected during the first few days of the attack, before the formation of adhesions. If reduction fails, there remains a chance for recovery after sloughing of the intussusception, the mortality in cases in which this occurs being only 41 per cent. while in those in which sloughing is absent the death-rate is 85 per cent. Even when sloughing does occur, however, and the patient recovers from the immediate risks of the process, he is by no means free from the danger of ulterior complications, the cicatricial contraction and adhesions

which follow often, as already mentioned, laying the foundation for future obstruction by stricture or internal strangulation.

The prognosis of *chronic intussusception* is also very grave: while the immediate risks to life are less than in the acute cases, there is not the same hope of recovery by sloughing and evacuation of the invaginated part, and, unless relief be afforded by an operation, a fatal result must be anticipated.

Treatment.—The indications for treatment in *acute* intussusception are to put the bowel completely at rest; if the case is seen at an early period, to attempt reduction: and, if the invagination has already become irreducible, to sustain the patient's strength until separation of the strangulated part may occur, when recovery may be hoped for. The first indication is met by the free use of opium, preferably in combination with belladonna. These remedies are best given in the form of the extract, by suppository, and of the former one-twelfth of a grain, and of the latter one-twenty-fourth, may be administered to a child of two years, every hour or two hours according to the urgency of the symptoms. Morphine and atropine may be used hypodermatically instead, but the rectal administration is, on the whole, I think, to be preferred. Advantage may also be derived from the employment of anodynes locally, and the abdomen may be covered with belladonna and mercurial ointments spread upon lint or flannel and reinforced by a warm poultice. In the attempt to effect reduction the physician may employ large *injections* of warm water, or, which is, I think, better, warm olive oil; *inflation* with atmospheric air or various gases; and manipulation or *abdominal taxis*.

The *injections* may be given with an ordinary hand-ball syringe or with a fountain syringe (gravity injection), the patient being etherized and held in a semi-inverted position, with the hips higher than the shoulders, and the trunk elevated at an angle of about 45°. The height to which the reservoir which supplies the fluid should be raised will be about eight feet in the case of an infant, and not more than twenty feet in that of an adult. The quantity to be injected may vary from one to six quarts according to the age of the patient. The injections are best administered through a large rectal tube, so that the force of the current may, if possible, be directed immediately upon the apex of the intussusception, and not expended upon the wall of the bowel. Care must be taken not to allow the fluid to escape alongside of the tube, by providing this, as suggested by Mr. Lund, with an India-rubber collar, which may be firmly pressed against the anus, or by wrapping it with cotton or lint, which is introduced within the sphincter to accomplish the same end.

Inflation with atmospheric air may be practised through the long tube or long-nozzled bellows, the same precautions being taken against escape of the air alongside of the tube as in the use of enemata. Professor Senn recommends the employment of hydrogen gas as preferable to atmospheric air, the gas being supplied from an India-rubber balloon holding four gallons, which is slowly but steadily compressed by the operator. Carbonic-acid gas is preferred by Libur, Jate, and Ziemssen, and is furnished in a nascent state by successively injecting solutions of bicarbonate of sodium and tartaric acid. *Abdominal taxis* was introduced as a mode of treatment in these cases by Mr. Jonathan Hutchinson, and consists in systematically compressing and kneading the belly from below upward, the patient being etherized and in an inverted position. In combination with the use of enemata it has occasionally proved an efficient remedy, but its employment is necessarily attended with some danger of injury to the bowel, and should therefore, it seems to me, be resorted to with caution, and only during the early stages of the case.

Reduction by one or other of the methods mentioned is most likely to be

accomplished during the first two days of an intussusception, and may occasionally be effected as late as the fourth day, but after that period should not be attempted, the physician's efforts being then directed to sustaining the patient through the processes of sloughing and evacuation of the strangulated intussusception. In this stage the use of opium and belladonna should be continued; little or no food should be given by the mouth, but the patient should be systematically fed by means of nutritive enemata. To relieve thirst, which is often distressing, water may also be given by enema, and the patient may suck small pieces of ice. If the abdomen becomes very much distended, the stomach may be carefully *washed out* through a stomach-tube, thus allaying vomiting and evacuating the liquid contents of the upper portion of the small intestine; or gas and fluid may be withdrawn by puncturing a distended segment of bowel with the fine tube of an aspirator. *Puncture of the bowel*, practised in this way, entails a certain risk of fæcal extravasation, but is followed by less shock than enterotomy, which, however, may be preferred when the patient's condition does not forbid it.

Enterotomy—or, as it is sometimes called, Nélaton's operation—consists in making an incision, usually in the right iliac region, and opening the first distended coil of intestine which presents itself. This may be done in two ways: if it is not desired to establish a false anus, a knuckle of bowel is gently drawn out through the wound, and, having been packed around with sterilized gauze, is opened, preferably by a transverse incision, and allowed to discharge itself outside of the abdominal cavity; if the evacuation is not sufficiently complete, a full-sized drainage-tube may be introduced into the gut, and the surgeon sits by the patient, keeping the bowel under observation, if necessary, for several hours, until the fæcal flow has entirely relieved the tension; the tube is then removed, the opening in the intestine closed with a Lembert's suture, the bowel replaced, and the external wound closed and dressed in the ordinary manner. If it be thought better to establish temporarily a false anus, the bowel should first be stitched to the abdominal parietes, then carefully opened, and the edges of the incision again stitched to the external wound so as to prevent any possibility of fæces escaping into the cavity of the peritoneum. If the case does well, after the separation and evacuation of the gangrenous intussusceptum the false anus may be allowed to close, as it usually will without difficulty as soon as the natural passage is restored. If the opening degenerate into a fæcal fistula, a plastic operation may be required for its relief.

The mode of treatment above described is that which I would recommend in cases of *acute* intussusception. *Laparotomy*, which may be required in cases of *chronic* invagination, does not seem to me desirable in cases of the acute variety, and is shown by statistical investigation to have no effect in diminishing the death-rate of the disease. Thus, while Leichtenstern's collection of 557 terminated cases, taken all together, gives 151 recoveries and 406 deaths (73 per cent.), the tables published in the fifth edition of my *Surgery* give 95 cases treated by laparotomy, with 26 recoveries and 68 deaths (1 undetermined), showing an almost identical percentage of mortality. Fitz's statistics present the operation in a still less favorable light, 51 cases treated without operation having given 16 recoveries and 35 deaths (69 per cent.), while 36 operated on gave only 6 recoveries and 30 deaths (83 per cent.). The objections to the operation in acute cases are that there is, as has been seen, a reasonable chance of recovery without it, and that the early age at which intussusception usually occurs renders operative interference peculiarly dangerous. I am well aware that a few brilliant results from laparotomy in infants

have been recorded by Mr. Hutchinson, the late Dr. Sands, of New York, and other operators, but these cases should be regarded as surgical curiosities, showing what infants may sometimes safely endure, rather than as furnishing precedents for future guidance. In *chronic intussusception* the circumstances are somewhat different. As the strangulation of the intussusceptum is not sufficiently complete to offer a chance for recovery by the process of sloughing, when the surgeon finds that reduction cannot be effected the operation may be properly resorted to, particularly as in these cases the patients have usually passed the period of infancy. When the bowel protrudes through the anus, the plan suggested by Howse, and successfully employed by Mikulicz, Willard, Fuller, and others, may be tried, the protruding portion being held from retracting by strong pins, and then cut off; but under other circumstances laparotomy is the proper measure.

Laparotomy for intussusception may be thus performed: The patient having been etherized and the abdominal wall carefully cleansed, an incision is made directly over the tumor if one can be recognized, but otherwise in the median line. The wound is carefully deepened until the peritoneum is reached, when this is opened with every precaution against injury to the bowels or other viscera. If the intussusception is found, the invaginated gut is brought out through the incision, the rest of the intestine being gently pressed back with warm towels or sponges, since the exposure and chilling of large portions of bowel always produces an unfavorable effect on the patient. Careful attempts at reduction are then to be made by gently compressing and pushing upward the invaginated part from below, this being at once safer and more efficient than efforts to withdraw the gut by traction from above. If the intussusception is not immediately found, the surgeon introduces his hand, through the incision, which in this case would be median, and explores the right iliac fossa, as recommended by Mr. Treves, finding the cæcum, and then searching upward or downward according as that part is empty or distended with fæces. In examining the small intestine the direction in which the search should proceed may be determined, as suggested by Mr. Head, by observing the relations of the mesentery, which is attached to the posterior wall of the abdomen from the left side of the second lumbar vertebra, obliquely downward to the right sacro-iliac symphysis. If reduction cannot be effected, the surgeon may proceed to the establishment of a false anus immediately above the seat of invagination, or, if the state of the patient should permit more prolonged manipulation, he may excise the intussusception bodily (*enterectomy*), and restore the continuity of the bowel either by direct suture (*circular enterorraphy*) or by Prof. Senn's method of *lateral anastomosis*, as may be thought best. The latter procedure or one of its modifications—for a description of which the reader is referred to special works on surgery—is ordinarily preferable, as requiring less time than the end-to-end suture. The subsequent treatment is to be conducted as after laparotomy for other causes, as has been described in the article on Diseases of the Appendix.

INTESTINAL PARASITES.

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The older writers on the diseases of children devote a good deal of space to the subject of intestinal worms, particularly to the symptoms supposed to be caused by them, and to their treatment. Text-books of to-day dwell more upon the natural history of these animals—an extremely interesting subject—but are apt to pass very lightly over the practical considerations of symptomatology and treatment. Although intestinal worms, like the teeth, have with propriety been dethroned from their high position as etiological factors in many of the diseases of children, we must not be carried too far with the swing of the pendulum and disregard entirely the parasite as a causative agent. Among the laity, with exceptions among the upper classes, worms still hold a very important position, and it is essential, therefore, that we should look at the subject fairly, and not pass it off as of very minor importance.

There are no intestinal parasites peculiar to infancy and childhood, although the round- and pin-worms are so much more common in children than in adults that they are often spoken of as peculiar to children.

Omitting several varieties that are rarely encountered and are of no practical importance, the species of worms that are found in children are as follows: Ascaris lumbricoides, round-worm; oxyuris vermicularis, pin-worm; two species of tape-worms, tænia mediocanellata, beef tape-worm, and tænia solium, pork tape-worm; and the unimportant trichocephalus dispar. All of these are Nematode worms, with the exception of the tæniæ, which belong to the group of Cestodes.

As these parasites have different habits and habitats, and each requires a special treatment, it will be necessary to consider them individually.

I. Ascaris Lumbricoides (Round-worm).

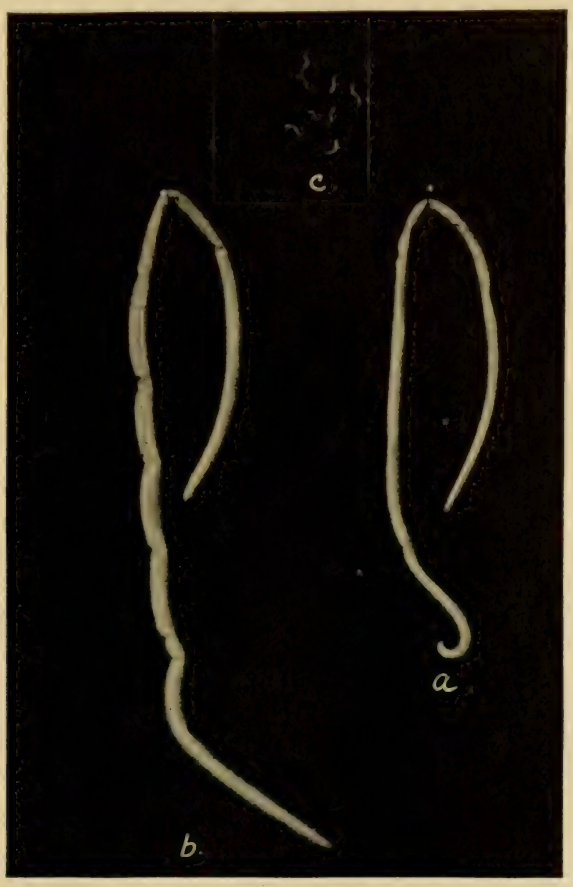
The male round-worm is from four to six inches in length, the female about ten inches. It is of a yellowish-white color, more or less tinged with red in the fresh state; as usually shown, preserved in alcohol, it is of an ivory white. The worm is cylindrical in shape, tapering to a point at both ends. The mouth is situated between three lips furnished with fine teeth at the anterior extremity of the body. The anus is about an inch from the posterior extremity, and the vulva in the female is anterior to the middle. The sexes are easily distinguished by their relative size and by the fact that the posterior extremity of the male is curved, that of the female being straight (Fig. 1, *a* and *b*).

From earth-worms, which I have known to be presented by patients with the intention of deceiving, they may be distinguished by their color and by the fact that earth-worms, being annelids, have plainly-marked segments. Female lumbricoids which have been carelessly handled and subjected to pres-

sure often show the ovaries hanging out like a bunch of small worms, and may deceive the superficial observer.

The ova of the round-worm are produced by the females in great quantities,

Fig. 1.



Round-worms and Pin-worms (⅔ Natural Size). *a*, Male Round-worm: *b*. Female Round-worm; *c*, Female Pin-worm.

and pass off in the fæces, where they can easily be found with the microscope. They are oval in shape, about $\frac{1}{400}$ of an inch long, with dark granular contents and thick transparent coats, which are often stained yellow by bile (Fig. 2, *c*).

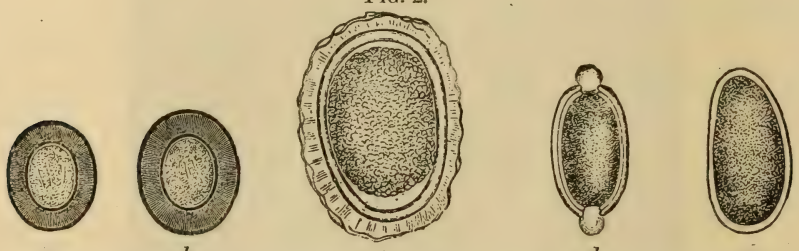
The proper habitat of the adult ascarides is the small intestine, but they are of a wandering disposition, and have been found in the stomach, œsophagus, and mouth, occasionally getting up into the posterior nares and coming out anteriorly, or going down into the larynx or even into the lungs. They also wander down into the rectum, and are expelled with the fæces or slip out unattended. They have even escaped into the peritoneal cavity through perforations made, not by them, as was once supposed, but by ulcerations. They have been known to pass into the pancreatic and biliary ducts. When in large numbers the worms are often coiled together into balls in the intestines. The ova do not develop until they have passed out with the fæces, and have again found their way into the child's gastro-intestinal canal, when the embryos

rapidly come to maturity. Outside of the body they resist destructive agencies with great obstinacy, and it is said may retain their vitality for years.

Method of Infection.—As the ova are produced in such countless numbers—Davaine having found some three thousand eggs in a bit of fæces as large as a grain of wheat—and as they are so resistant to outside destructive agencies, it is not surprising that they should be very common among the classes of individuals where personal cleanliness is not cultivated. As children are greater barbarians in their personal habits than adults, it is natural that ascarides should be much more often found among them. The habit children have of putting their fingers as well as toys and other objects into their mouths might easily lead to self-infection with ova from parasites in their own intestines, as well as with ova from elsewhere. In the country, infants creeping about the floor may be infected by the dust brought in on the shoes from manure-heaps.

Among the upper classes ascarides are certainly very much less common, and they are rarely seen in the adult. Here, where habits of cleanliness are

FIG. 2.



Comparative size of eggs of Intestinal Parasites: *a*, Tænia Solium; *b*, Tænia Mediocanellata; *c*, Ascaris Lumbricoides; *d*, Trichocephalus Dispar; *e*, Oxyuris Vermicularis. (After Strümpell.)

cultivated, infection would be more likely to come only through drinking-water or food. If the contents of privies are used in the garden for manure, the contained ova may readily find their way into water used for drinking or be served with salads or other uncooked vegetables. By proper filtration of the water or by cooking of vegetables, this danger can be escaped.

Symptoms.—It is not uncommon to find numerous intestinal worms in the lower animals without any evidence of ill effect, and it is frequently the case that we discover lumbricoides, in greater or less numbers, in the dejections of children who are well in every way and have presented none of the classical symptoms of worms. It is certainly the case, therefore, that, while the round-worm is confined to its proper place—the small intestine—even if it be in great numbers, it may be, and generally is, entirely harmless, and has no appreciable effect on the condition of the child, producing no symptoms. The amount of nourishment it extracts for itself is hardly worth considering unless the worms exist in great numbers.

On the other hand, when we consider the high state of nervous tension that exists in the child, and the ease with which reflex phenomena are produced, it is reasonable to suppose that the presence of the living worms in the intestine may cause certain reflex symptoms, and in that way interfere with the general health.

The common symptoms ascribed to round-worms by the laity are general lassitude, with nervous fidgeting, picking at the nose, offensive breath, abdominal pain, headaches, feverish attacks—called "worm fever"—and lack of flesh, notwithstanding a fair, or at times ravenous, appetite. The bowels are irregular, there being either constipation or diarrhœa with mucous discharges. There

may be vomiting and disturbed sleep with grinding of the teeth. This is the common and exact picture of a child debilitated by improper feeding and an insufficiency of fresh air and exercise—a child that is cooped up with many others in close school-room air, and whose whole life is poorly managed from a hygienic point of view. That such children sometimes have ascarides is not surprising when we consider the ease of infection, but that the parasites are the cause of their condition is certainly not the case, although the nervous symptoms may undoubtedly be aggravated by them. It is probable that these debilitated children, with plenty of mucus in their intestines, are more desirable habitats for the round-worms, so that the parasites thrive in this class and retain their foothold, while healthier children more easily get rid of them.

The symptom, picking the nose, is often spoken of by mothers as if it were pathognomonic of worms. This is not the case; it is simply a nervous trick common to debilitated children, as is often proved by the unproductive administration of anthelmintics. My experience is that in the majority of cases where round-worms are found, their presence is unsuspected and their discovery accidental. Having once been found, it is common enough for almost any symptom to be attributed to them by the mother.

Numerous cases have been reported, however, where the connection between the worms and severe nervous symptoms, such as convulsions, chorea, aphonia, etc., seemed to be very intimate, the nervous symptom being relieved on the evacuation of the parasites.

One such case is recorded among those in the Boston Children's Hospital:

> Kate M——, four years old, had had two convulsions before she came under observation. She was in good general condition, and no reflex cause could be found for the convulsions except round-worms, which she had passed from time to time. She was given santonin: a quantity of worms were expelled, and she remained well for six months, when she had another convulsion. Worms were again brought away, but she came back a month later, reporting occasional attacks of twitching and tremors, but no real convulsions. Anthelmintic treatment again expelled round-worms, and she was lost sight of for three years, during which there was no history of worms or nervous phenomena. At the end of this time she again applied for treatment for attacks every two or three weeks of flushing and pallor, pain in the belly and convulsions. Santonin was again given, bringing away worms and giving relief as before.

There is a certain mechanical danger from ascarides, owing to their habit of wandering. A number of cases have been recorded of these worms entering the cystic and common bile-ducts, giving rise, in the latter case, to jaundice. They have even penetrated to the hepatic ducts and caused abscesses of the liver. They have also been found in perityphlitic, hernial, and tubercular abscesses connected with the intestine, having wandered into these abscesses after their formation, and possibly in some cases contributing to the irritation and suppuration there. That they may cause perforation of the normal intestine is not the case, but when we consider their stiffness and activity during life, and their sharply-pointed extremities, it does not seem unlikely that they might break through an ulceration which needed only the last straw, so to speak, but which otherwise might have healed.

Another danger from round-worms arises from the fact that they sometimes ascend—with or without the aid of vomiting—into the fauces, whence they may be drawn into the larynx and cause suffocation and death. If the worm be drawn into the trachea or a bronchus and is not expelled, death is not immediate, but ensues in three or four days from gangrene of the lung. The fact that a child is found dead with a lumbricoid in the larynx does not, however, necessarily prove that this was the cause of death, for these worms

not infrequently wander away from the intestine after death from other causes. In the majority of cases when the worm ascends to the fauces it is expelled through the mouth, or more rarely, through the nose.

When the parasites are collected in great numbers in the intestine, they may mechanically cause congestion of the mucous membrane, and even obstruction of the bowel, or volvulus. In these cases the worms are found tightly twisted together, forming an obstructive ball.

Hillyer, in the *Lancet* (1892, ii., p. 773), relates an interesting case of this sort, where there were at the same time extreme nervous symptoms:

> A child, five and a half years old, never strong, began to have severe abdominal pains, for which castor oil was given with the result of causing vomiting, but no action of the bowels. Three round worms were found in the vomitus. The child then became unconscious, the eyes wide open, the pupils dilated, the skin cold and clammy. Death ensued on the following day. At the autopsy the ileum was found occluded at a point fifteen inches above the ileo-cæcal valve by a tightly-wound ball of eight round worms. Forty-two worms in all were found in the intestine. There was extreme congestion of the intestine above the obstruction and at that point. Below the obstruction the bowel was empty, above it was distended.

Diagnosis.—This can never, and should never, be made without seeing the worms themselves or their eggs. Mothers in their anxiety often mistake shreds of mucus for worms, so it is essential that the physician should see the suspected parasites in every case. As was stated above, debilitated children with mucus in their dejections are the ones that present symptoms popularly thought to be diagnostic of worms.

The ova are so numerous that they are easily found in the sediment of liquid stools; this can be scraped from the napkin or taken up with a pipette, or the residue examined after filtration. If the stools are not naturally liquid, they can be stirred up with water. A method suggested by Epstein is simple and effective,—viz. the introduction of a Nélaton catheter into the rectum. The small amount of fæces that will cling to the eye of the catheter is more than sufficient for microscopic examination. The power generally used for urinary sediments—*i. e.* about 330 diameters—answers for these examinations. The eggs, which have been described above, are easily recognized (Fig. 2, *c*), and readily distinguished from the smaller, sharper, oval eggs of the pin-worm and the round eggs of the tape-worm.

Treatment.—Although ascarides, as a rule, cause no discomfort and are in no wise detrimental to the host, when we consider the various accidents, some of them fatal, which may be caused by them, as well as the obscure nervous symptoms which occasionally owe their origin to this source, it is certainly wiser to treat all cases as soon as they are discovered, and to get rid of the worms.

Of the remedies that can be used for round-worms, it is hardly worth while to mention more than three. These are santonin, spigelia, and chenopodium. All of these have the power of killing or benumbing the parasites, but require the aid of cathartics to cause their expulsion.

Santonin, made from Levant worm-seed, is probably the most widely used of all anthelmintics. It is the common basis of proprietary worm-lozenges. Care should be used in its administration, as it is extremely poisonous in overdoses, several fatal cases having been reported. In poisonous doses it produces gastro-intestinal irritation, dizziness, tremor, yellow vision, dilated pupils, and loss of consciousness, with, at times, convulsions. Santonin is an almost tasteless white powder, nearly insoluble in water. It can be given in powder mixed with sugar, or made up into lozenges. The dose at the age of two years is

$\frac{1}{4}$ to $\frac{1}{2}$ grain; at six, 1 grain; and at twelve or fifteen, 2 grains. It should be given morning and night, or in some cases three times daily, with the addition of a cathartic—calomel, castor oil, or cascara cordial—every second day as long as lumbricoids continue to be passed. When it is remembered that very grave symptoms have been caused by a dose of 4 grains to a child four years old, and that a feeble child of five has been killed by 2 grains of santonin, it is easily seen that care must be used in its administration, and that there is danger in its indiscriminate use.

Spigelia, or pink-root, one of our native plants, is also an efficient and, in proper doses, entirely safe drug. The freshly prepared fluid extract of spigelia and senna[1] of the Pharmacopœia of 1870 combines the necessary cathartic with the anthelmintic in a manner both efficient and pleasant to the taste. The dose is half a teaspoonful for a child of two years, a teaspoonful for one from four to ten years old. It should be given two or three times daily, depending on its effect upon the bowels.

Oil of chenopodium is the third remedy for ascarides, and is said to be safer and less irritating than the others. It can be given on sugar in doses of five drops to a child of three, and ten drops to one of ten years, three times daily. A cathartic is required, as with the other anthelmintics, and should be given every second or third day.

II. Oxyuris Vermicularis (Pin-worm, Thread-worm, Seat-worm).

This is a small worm, as the first two of its common names would imply. (Fig. 1 shows the comparative size of pin- and round-worms.) The female is from a quarter to half an inch in length; the male, only about a third as large, measures from $\frac{1}{12}$ to $\frac{1}{6}$ of an inch. Its color is nearly white, its shape fusiform, tapering to a fine point in the female, having a blunter and generally curved tail in the male. The mouth is situated in the middle of the blunt end, and is surrounded by three slightly projecting lips (Figs. 3, 4). The eggs are ovoid in shape, more pointed at one end. They measure 0.053 mm. in length by 0.028 mm. in breadth, are considerably smaller than the eggs of ascaris, and have a thinner and smoother coating (Fig. 2, *e*).

This worm inhabits the rectum and large intestine throughout its entire course, as well as the lower end of the small intestine. The eggs are passed out with the fæces in great numbers, and, when swallowed, the embryo is set free in the digestive tract and descends to the colon, rapidly developing into the adult worm. The number of these parasites in one individual may be so enormous that the whole mucous surface of the colon and rectum becomes coated with them, as if with a layer of pus. In the cæcum, where they are undisturbed, the sexes are about equally divided. In the rectum and in the stools the females preponderate, as, owing to their larger size, they are less easily destroyed than the smaller more fragile males. The great preponderance of females is also partly apparent, as the males, from their minute size, are often overlooked. Pin-worms are frequently seen alive outside the anus in the folds of skin, sometimes getting into the groins, and in little girls they often crawl into the vagina.

Method of Infection.—Auto-infection is constantly taking place in children having pin-worms. The irritation caused by the worm leads them to scratch about the anus; numerous eggs become lodged under the finger-nails, and are later taken into the mouth and stomach. It is very common to find

[1] This can be written for directly. Its formula is as follows: ℞. Ext. spigeliæ fl., f℥x.; Ext. sennæ fl., f℥vj.; Olei anisi, ♏xx.; Olei cari, ♏xx.

several children in one family suffering simultaneously. Food and toys that are handled by these children become carriers of the infection. Vegetables and drinking-water may also be infected, as in the case of round-worms.

Symptoms.—The oxyuris gives rise to a very evident symptom in nearly all cases—namely, an intense itching about the anus, which leads the patient to scratch vigorously, causing bleeding and in some cases setting up an eczema. The itching occurs most severely in the early part of the night while the patient is in bed. It is thought to be due to the movements of the worms in the rectum, and is entirely relieved by their removal from this point, even if they remain in quantities higher up. In fact, it is probable that the parasites while in the small intestine produce no appreciable symptoms.

Fig. 3.



Oxyuris Vermicularis: *a*, Male, Natural size; *b*, The same enlarged. (after Beneden).

As a result of the itching the sleep of the child is disturbed, and various slight nervous symptoms may be induced. Grinding of the teeth, crying out in sleep, involuntary twitching, and insomnia are common. In one of my cases pavor nocturnus was apparently caused by the reflex irritation of the worms; and in a very sensitive child it is probable that reflex convulsions or chorea might ensue. As a result of the disturbed rest and of the more or less constant irritation, the patient is often debilitated, peevish, and nervous, and, like all nervous children, apt to acquire the trick of picking the nose, and to have occasional reflex feverish attacks. He may, however, escape without a symptom.

In two of the pin-worm cases at the Boston Children's Hospital fainting was a prominent symptom. One of these, a girl of ten years, was said to have "worm-fever" about once a month. At this time she had fainting attacks and passed great quantities of the parasites.

Fig. 4.



Oxyuris Vermicularis: *a*, Female, Natural size; *b*, The same enlarged. (After Beneden).

As a reflex cause of incontinence of urine these parasites hold a well-recognized place. In eight of the hospital cases incontinence existed. In girls vulvo-vaginitis is sometimes caused by the irritation of the worms that have found their way into the vagina; this, in turn, is also a cause of incontinence of urine. Nine instances are recorded among 48 cases at the hospital. As 34 of these cases were in girls, this makes a proportion of 27 per cent. of vulvo-vaginitis from this cause. The great preponderance of females in this list, 34 to 14, may be partly explained by the urgent symptom of vulvo-vaginitis calling them to the hospital for treatment. Curiously enough, the same preponderance of girls is also found in the round-worm cases—11 girls to 5 boys. Masturbation in either sex may be caused by the irritation. One of my cases had a rectal polypus, probably due to rectal irritation. Prolapse of the rectum may be set up by the straining. As to the age at which these worms are chiefly found in children, 35 of the 48 cases at the hospital occurred in children between two and seven years old, inclusive. The youngest was an infant of twenty-one months.

As bearing on the frequency of worms in general, and of each species in particular, I have examined the out-patient records of the Boston Children's Hospital, and find that out of 5200 medical patients of all kinds, there were 65 where the diagnosis of worms was made on the evidence of the parasites themselves. My general impression was that the round-worms were more common than the pin-worms in children, and this is so stated by Councilman in the *Cyclopædia of the Diseases of Children*. A much larger number of the latter were seen at the Children's Hospital, however, owing no doubt to the more urgent symptoms they produce, and the general absence of symptoms in round-worms. Forty-eight of the 65 cases had pin-worms, and only 17 round-worms, 3 of these being afflicted with both varieties. The remaining four had tape-worms—in 1, Tænia solium; in 1, Tænia mediocanellata; and in 2 the species was not accurately determined.

Diagnosis.—As in all cases of intestinal parasites, the diagnosis can only be made with certainty by the discovery of the worm itself or the ova. The history of anal pruritus in a child should always lead one to suspect the presence of pin-worms, and the anus and its neighborhood should be carefully searched. By the use of an enema large numbers of the worms may be brought to light. By examining under the microscope scrapings from beneath the finger-nails, the folds about the anus, or the detritus scooped out from inside the anus with a grooved director or catheter, the eggs are often found in large quantities, and are easily recognized, as described above. In all cases of incontinence of urine, masturbation, and leucorrhœa the oxyuris should be thought of and sought for.

As in the case of lumbricoids, intestinal mucus, which in greater or less quantity is mingled with fæcal discharges, has often been mistaken by the nurse or mother for pin-worms, as is illustrated by the following case:

Allen M——, three and one-half years old, was brought to my clinic at the Boston Children's Hospital with the history of having passed great quantities of pin-worms in the last few days. His symptoms, which the mother attributed to the worms, were vomiting, slight diarrhœa, with feverishness and general debility. He had a similar attack a year ago, and was thought to have passed worms then. Examination in the folds about the anus failed to reveal any worms, and a microscopical examination of detritus from under the finger-nails, outside the anus and inside the anus was negative as regards the finding of ova. The mother brought next time some of the fæces which she believed to be swarming with the worms. The fæcal mass when placed in water showed plenty of stringy mucus, which, gathered in thread-like clusters, certainly simulated very closely actual pin-worms. There was in this case undoubted irritation of the intestine, giving rise to various symptoms suggestive of worms, and to an extra secretion of mucus. The irritation, however, was due to an improper diet, not to worms.

Treatment.—As long as any worms remain in the bowel there is a constant source of infection. Treatment must therefore result in the complete expulsion of the parasites, or we shall have, what is often unfortunately the case, a relapse or return of the trouble. Besides this, measures must be taken to prevent reinfection from the old sources after cure. If the worm confined itself to the rectum, as is erroneously believed by some, treatment from below with injections would be simple and effectual. This treatment, although giving relief for a time, is of course entirely inadequate, as many of the worms are out of reach in the cæcum or even in the lower part of the small intestine. The proper method, therefore, is to make the attack both from above and below. By the mouth may be given either santonin, spigelia, or chenopodium, with a cathartic, in the manner already described in the treatment of ascarides. Cathartics which produce free watery discharges are found to be particularly efficient in the treatment, even without a previously administered vermicide

Epsom salts, Seidlitz powder, or Hunyadi water are therefore to be recommended, but are all unfortunately distasteful to children. The syrup of raspberry disguises very well the taste of Epsom salts in a 25 per cent. solution, thus:

℞. Magnesii sulphatis . . . . . ʒiv.
Syrupi rubi idæi . . . . . fʒij.—M.
Sig. A tablespoonful containing one drachm of the salts.

The vermicide and cathartic may be given by the mouth two or three days in the week.

Once a day the rectum should be washed out with a copious enema of cool soapy water. By using a soft-rubber catheter attached to the nozzle of the syringe the enema can be introduced higher up, and will be more effectual. Plenty of water should be used, so as to distend the folds of the rectum and colon in which the worms are lodged. Cold water alone is effectual in washing out and killing the worms, but the addition of castile soap makes it less irritating to the bowel and more fatal to the worm; and this addition is all that is necessary if the injections be given thoroughly. Other substances are often used in solution in the enema for their destructive effects on the worm. These are common salt, quinine, quassia, alum, tannin, etc., but it may be doubted whether these solutions are any more effectual than properly given injections of soap and water. Where there is relaxation and protrusion of the rectum an astringent injection is of use, as, for example, one drachm of sulphate of iron to one pint of infusion of quassia; or a solution of tannin can be given, in the proportion of a heaping teaspoonful to a pint of water. All irritating injections should be avoided, and dangerous ones, like solutions of corrosive sublimate, had better not be used.

As the worm or its ova may live in the folds about the anus, these parts should be carefully scrubbed with soap and water and anointed with an antiseptic ointment. Boric-acid ointment, as in the following prescription, besides destroying worms, is of use in allaying the irritation or eczema caused by their presence:

℞. Acidi borici . . . . . ʒj.
Olei rosæ . . . . . gtt. iij.
Vaseline . . . . . ʒj.—M.

Even after a complete cure, obtained by the expulsion of all the worms, reinfection is likely to take place unless certain precautions are taken. The bed-clothing, the blankets, as well as the linen, may contain the eggs of the oxyuris; the toys undoubtedly have some lodged in their crevices; and the carpet or floor may be more or less infected, for it must be remembered that a small bit of fæcal matter spilt from a vessel or napkin may contain thousands of eggs. The room and its contents should therefore be almost as thoroughly cleaned as in the case of one of the exanthemata. The bed-clothing should be boiled, the toys destroyed, the carpet and rugs thoroughly beaten, and the floor and furniture scrubbed with soap and water. The neglect of this undoubtedly accounts for the frequent failures to cure this troublesome affection.

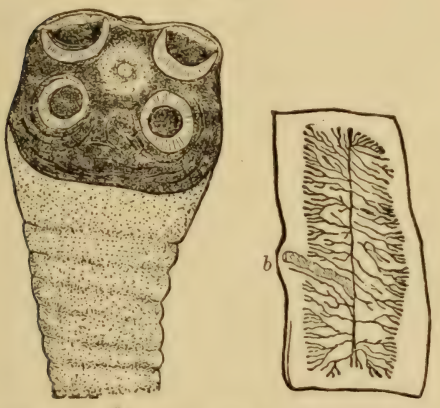
III. Tænia (Tape-worm).

The common tape-worm is from twenty to fifty feet in length, of a white color, and composed of numerous flattened segments, each of which, except

those near the so-called head, is a complete hermaphrodite. Nourishment is absorbed through the body-walls from the contents of the intestinal canal, in which the whole worm lies immersed. The "head" is a modified segment about the size of the head of a pin, and it is by this organ with its suckers or hooks that the worm retains its hold on the intestine. The segments near the head are not much broader than a piece of thread, but they rapidly increase in size and become from one-quarter to one-half an inch broad at the other extremity of the worm.

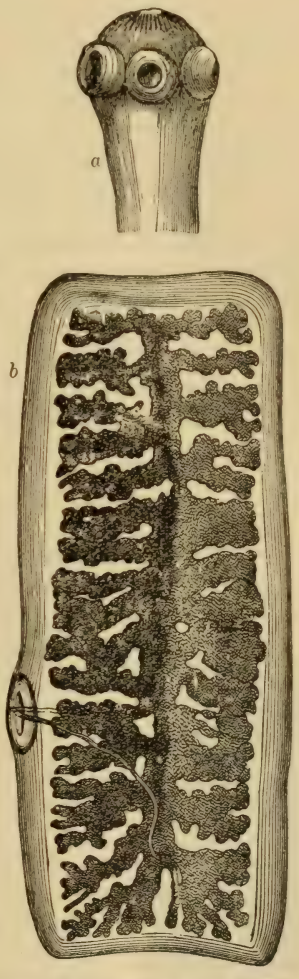
Varieties.—The two species commonly found in this country are the beef tape-worm, *Tænia mediocanellata*, and the pork tape-worm, *Tænia solium*.

FIG. 5.



a
Tænia Mediocanellata. Head and Mature Segment, Enlarged (Heller).

FIG. 6.



Tænia Solium. Head and Mature Segment, Enlarged. (Beneden.)

Two other species may be mentioned, as they are sometimes encountered: *Tænia nana* and *Tænia cucumerina*. Another species, belonging to a different genus, *Bothriocephalus latus*, is found only in certain parts of the continent of Europe.

The beef and pork tape-worms (Figs. 5 and 6) are easily distinguished by their heads, and less readily by the sexually mature segments. The pork tape-worm has a circle of hard chitinous hooks on the head, with four sucking disks, and the head itself is somewhat pointed. The head of the beef tape-worm is not pointed, and is provided with four suckers only, being devoid of the circle of hooks. This species may also be distinguished by the sexually mature segments or proglottides which are passed from the anus. In the pork tape-worm the lateral branches of the uterus (Fig. 6, *b*), are only eight to twelve in number, and quite thick, while in the beef tape-worm the side branches are finer and are much more numerous, being twenty or thirty in number (Fig. 5, *b*). These can be seen by flattening out the segments between two microscopic slides and holding them up to the light. The addition of glycerin makes them more transparent.

Tænia nana has of late years been found to be very numerous in Italy, particularly in Sicily. It has been found in Egypt, and also in England. With so many Italians of the poorer class constantly coming to this country, its occurrence here is to be expected. It especially attacks children, and may occur in great numbers in one individual. It is very small, being only ten to fifteen mm. in length. The head is armed with four suckers and a rostellum with hooks, which can be protruded or entirely withdrawn. Severe nervous symptoms are sometimes caused by this worm.

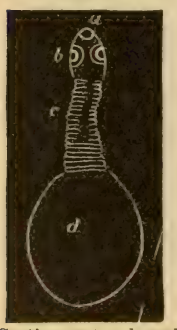
Tænia cucumerina is another rare form of tape-worm which especially infects children, being acquired by them from dogs.

Life History.—The ova are produced in each segment in great numbers, and those of the two common varieties of tænia are easily distinguished from the eggs of the round and thread-worms by their smaller size and spherical instead of oval shape. The eggs of T. mediocanellata are slightly larger than those of T. solium, which are about $\frac{1}{750}$ of an inch in diameter (Fig. 2, *a* and *b*).

The tape-worm lives in the small intestine, firmly attached to the mucous membrane by the suckers and hooks on its head. While the head is attached to the upper part of the jejunum, the other extremity, in the common species, may reach nearly or quite to the ileo-cæcal valve. The pork tape-worm is generally found singly, while two or more beef tape-worms may occur in the same individual. The worm grows by a process of breeding or segmentation from the segments close to the head. As these become farther and farther removed from the head by this process, they become larger and sexually mature. The first sexually mature segment of T. solium is about the four hundred and fiftieth from the head. Some of the ova are extruded from the lower mature segments, and pass off with the fæces, but most of them escape from the anus still contained in the ripe segments, which break off entire. These segments, besides passing out in the fæcal mass, may slip out of the anus into the underclothing; and this happens so frequently that attention is usually called to the presence of the worm in this way.

For the development of the eggs another host is utilized, this host being the hog in the case of T. solium, and cattle in the case of T. mediocanellata. In the case of the hog, with its fondness for grubbing around in heaps of offal and manure, infection easily takes place. Cattle may be infected in a similar way while cropping grass that has been fertilized with human fæces. In the animal's stomach the thick outer coatings of the ova are dissolved, the embryos are set free, and proceed at once to pierce the stomach-walls, and, carried along in the blood-current, bury themselves in the muscles, the liver or other viscera. Here they develop into cysticercus cysts, which in the pork tape-worm are a little larger than a pea, in the beef tape-worm somewhat smaller. Within these cysts the larval tænia or scolex grows, the head being formed with a short neck and a flask-shaped body (Fig. 7). These cysts remain quiescent for from three to six years, after which they die and become calcified. If, however, the flesh containing living cysts is taken into the human stomach, the larval scolex sprouts into the mature tape-worm and the cycle of changes is complete.

Fig. 7.



Cysticercus, or larval tape-worm.

It occasionally happens that the eggs of tape-worms are swallowed by men, and cysticerci may develop in various parts of the body, especially in the subcutaneous and intermuscular connective tissue, or in the brain or eye.

Method of Infection.—The consumption of raw or imperfectly cooked

meat, in which the temperature has not been raised to a sufficient point to kill the cysticerci, is the source of infection for tænia. Infants and children are liable to become infected with the beef tape-worm from the use of raw meat, sometimes recommended in intestinal troubles. When the beef is very finely minced or when the juice only is used, the beef being thoroughly pressed and strained, this danger is removed. The consumption of raw sausages is a more common cause of the pork tape-worm among continental nations than in this country; here the beef tape-worm is probably more commonly met with.

Children, from their uncleanly habits and their custom of sucking the fingers, are more exposed to the danger of swallowing the ova and developing cysticerci.

Symptoms.—The symptoms caused by tape-worms in the intestine are as obscure as those of round-worms, and, as with these parasites, are often lacking. A child, as well as an adult, may harbor a tape-worm for years, the only indication of this being the passage of segments from time to time *per anum*. Uncomfortable sensations in the abdomen and pain in the region of the navel, with the various nervous symptoms given under the head of Lumbricoids, such as picking at the nose, disturbed sleep, fitful and at times ravenous appetite, have been observed in these cases. There may be nausea and salivation, and vomiting is at times present. The bowels are often irregular. The movements of the worm in the intestine are sometimes described, but it is doubtful whether this is anything more than a psychical phenomenon. Failure to take on flesh notwithstanding a ravenous appetite is to the laity a characteristic symptom of tape-worm, but its significance is of very doubtful value, for it is a symptom often present without the worm, and is indicative of faulty digestion and imperfect assimilation. As with the other intestinal worms, chorea and convulsions have been attributed to tæniæ.

The following case came under my care at the Children's Hospital in July, 1890:

Angelina M——, four and a half years old, has had a tape-worm for two years. The mother has found segments frequently in her under-clothing and in the stools. She has been under treatment by various doctors from time to time, but without permanent relief, as the whole worm has never been expelled. The child was accustomed to eat a great deal of very rare beef. She complains of constantly feeling tired, is peevish and fretful, frequently picking the nose, and is restless at night. Her head perspires a great deal, her appetite is at times ravenous, and she complains of pain about the navel. The bowels are regular.

Under treatment—which I shall give below—she expelled a beef tape-worm twenty-four feet long, with the head entire. It is extremely interesting to note that a year later, in May, 1891, the patient returned, complaining of exactly the same symptoms, which had never been recovered from, but she never passed any more segments of worm.

Diagnosis.—There is no difficulty in making the diagnosis of tape-worm, for the mature segments slip from the anus at intervals of every few days or are passed in the stools. Their white color and peculiar shape at once attract attention, so that it is not necessary to make microscopic examinations of the fæces or to resort first to anthelmintic treatment. The distinction between the two common species of tænia is made in the manner detailed in the description of the worms. The fact that patients are apt to mistake shreds of mucus for worms, requires the physician to assure himself of the correctness of the identification before beginning treatment.

Treatment.—Having made sure that a worm is present, appropriate treatment should be at once instituted unless contraindicated by some acute illness;

for, although the worm in the intestine may produce no symptoms, there is always danger of cysticerci developing somewhere in the body from the accidental ingestion of the ova.

Half-hearted measures are sure to be failures, consuming time, irritating the child, and wasting its strength. To be successful the entire worm, including the head, should be obtained, although it often happens that if the worm be broken off close to the head and expelled, there is no return of the trouble. This can probably be explained by the fact that the head is in reality expelled, but, being so small, is not found in the fæcal débris. This is particularly apt to be the case if the mother or nurse attempt to find the head. It is much better for the physician himself to make the search. This should be done by adding water to the stool and shaking up the fæcal mass or stirring it gently with a stick, being careful not to break up the worm; by decanting the water from time to time and adding fresh, a clear mixture will be obtained in which it is easier to find the parasite.

Treatment consists, first, in the preparatory dietetic management; secondly, in the administration of some drug which experience has shown will kill or benumb the worm; and lastly, in the use of a cathartic to remove the offending body.

The preparatory treatment is partial starvation, in order to weaken the worm. For this purpose small amounts of such food as can be digested in the stomach are to be preferred, and the colon should be unloaded, so as to make the exit for the worm easy. As children cannot stand much starving, the preparatory period should be shorter than in adults, and it loses some of its irksomeness by including the night. After a light dinner the child should be given a bowl of beef-tea with a half slice of white bread for supper; an enema must be given in the evening and the child put to bed early. The breakfast must consist of beef-tea alone. An hour later, say at 9 A. M., the anthelmintic can be given, to be followed in one hour by the cathartic. The stools should be carefully preserved and examined as explained above. It sometimes happens that the worm is partially expelled by a movement from the bowels, and is left hanging out of the anus. In this case great care should be used not to break it off, a large injection being given to dilate the rectum and allow the removal of the worm by gentle traction. Dilatation of the anus by a small rectal or nasal speculum will take off the pressure of the sphincter and aid in extraction.

It only remains to consider the various tænicides recommended. The list is a large one, but I will mention only the important ones. These are—pomegranate, the bark of the root and its alkaloid pelletierine; filix mas, the root of the male fern; kousso; pumpkin-seed; turpentine; and cocoa-nut.

The first, pomegranate, is one of the most efficient. It can be given in a decoction, which, however, makes a disagreeable draught, and one apt to defeat its own purpose by causing vomiting. A much neater way, and one that I have always employed, is to use the alkaloid pelletierine. The tannate of this alkaloid is made into an elegant but very expensive preparation by Tanret of Paris, and is put up in small bottles containing one adult dose. This can be obtained in all our large cities, and its efficiency makes up for its high price. As pomegranate in full doses causes nausea, giddiness, faintness, and indistinctness of vision, it is best for the child to lie down after the dose is given. In the case of tape-worm in the child of four and a half years, related above, the preparation of the tannate of pelletierine was given, one-third of the bottle, which contained five teaspoonfuls, being administered at a dose. The child complained of slight dizziness and headache. An hour after the tænicide a full

dose of castor oil was given, and four hours later the worm was expelled entire.

The oil of male fern, oleoresina aspidii, is ths next most efficient remedy for tape-worm, a teaspoonful being given to a child of five years, shaken up with some agreeable menstruum, as in the following recipe:

℞. Oleoresinæ aspidii . . . . . ʒj.
Tinct. quillaiæ . . . . . fʒss.
Spts. aurantii dulcis . . . . . fʒj.
Syr. aurantii . . . . . q. s. ad fʒvij.—M.

Kousso appears to be used more by European than American physicians and is said to be efficient and free from danger. The freshly-prepared infusion is best used (infusum brayeræ, U. S. Ph.), but is very objectionable to children from its disagreeable taste, and is liable to produce vomiting.

Pumpkin-seed is a perfectly safe and simple remedy, but in my experience is never efficient, a small part of the worm being left behind to reproduce the trouble. The outer shell of the seeds should be removed, and the inside rubbed up with syrup or honey into an agreeable mass. One or two ounces of this can be eaten, followed, as in all cases, by a purgative.

Another agreeable remedy is the meat of the cocoa-nut. From large quantities of this there have been favorable reports lately, but as cocoa-nut is rather indigestible it might have an untoward effect on the child.

With pelletierine or male fern, preferably the former, properly given with all the details of treatment attended to, success should always finally crown our efforts, and it seems to me better not to waste time with any other remedies.

IV.—Trichocephalus dispar (Whip-worm).

This is a small worm, thickened at one end, but tapering out like a whip-lash at the other. It is four or five centimetres long, and lives in the cæcum where it is often found in large numbers (Fig. 8). The eggs (Fig. 2, *d*) are about the size of the ova of the pin-worm, from which they are easily distinguished by the irregular rounded shape. At each extremity is a break in the egg-walls. Of 16 children examined for this purpose, I found the eggs of this worm in the fæces of one. The worm gives rise to no symptoms, as far as known.

Fig. 8.



Trichocephalus Dispar (Heller).

DISEASES OF THE LIVER.

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Diseases of the Liver are not of frequent occurrence in childhood. The factors essential for the development of hepatic disorder require the element of time to aid them. This is one reason gall-stones, for instance, do not occur in early life. Moreover, the customary food and drink of early childhood do not influence hepatic function and nutrition deleteriously, and therefore functional derangements, hepatic congestion, and sclerosis are relatively infrequent. Other etiological factors of liver disease in adult life are not operative in childhood. The liver is more frequently the seat of secondary disease than possibly any other organ. The primary diseases usually occur in adult life, and hence the secondary effects are only observed at that period. For instance, cancer of the liver and abscess following amœbic dysentery are not of frequent occurrence in childhood.

While the above applies chiefly to organic disease of the liver, the writer fully believes that functional disorder in late childhood and early adolescence is of more frequent occurrence than we are led to believe from the text-books. If the broad view of Murchison be true, that lithæmia and allied disorders with their long train of functional derangements in the gastro-intestinal tract, the nervous system, and the circulatory apparatus, or their results, terminate in organic disorder of liver, kidney, arteries or nerve-structure, we must believe that the beginnings are found in the errors of diet, the improper clothing, the misguided exercise, the vicious methods of education, and abnormal excitements of the nervous system which occur in childhood. It is true the physiological labors of the liver are so closely related to, or rather so markedly an adjunct to, the physiological labors of other organs of the primæ viæ that it is almost impossible to fix upon the disturbing factor when disorder is observed. Hence a clinical distinction between malnutrition and malassimilation cannot be made. Functional disorders, therefore, will not be discussed in this chapter, and for the above reasons are usually excluded in works on diseases of children.

Diseases of the gall-ducts, save catarrhal inflammation, are due either to gall-stones (not present in childhood) and their consequences or to diseases outside of the duct that do not arise in early life. Hence affections of these passages need not be considered.

General Etiology.—The causes of liver disease in childhood do not differ from those in adult life, though they are not as frequently operative, or the results of their operation are not seen. Icterus neonatorum and congenital obliteration of the ducts are the diseases of the liver peculiar to childhood, and therefore have a distinct etiology. Other affections of the liver are common to both periods. Errors of diet, excess in rich food or in stimulants,

cause congestion of the liver in children as in adults. Seasonal changes are factors, although it seems that high temperature does not often tend to cause acute congestion of the liver in children; at least, writers on tropical diseases do not specifically refer to the occurrence of acute congestion in early life. Malaria causes congestion of the liver at any age; checking of discharges or chronic constipation are not marked factors in childhood; but the congestions that arise in the course of infectious diseases are more commonly found at this time. Scarlet fever, measles, and, notably, relapsing and yellow fever, are attended by congestion of the liver. In passive congestion we find the same influences at work in the child and the adult. The effects of obstruction of heart and lungs are similar.

As in congestion, so in fatty liver, the causes are not peculiar. In children abnormally obese or the subjects of phthisis or profound anæmia, the disease is liable to occur, just as in adult life. The same is true of amyloid disease; prolonged suppuration alone or in tuberculous bone disease or in tuberculosis of the lungs leads to its frequent occurrence in children. Syphilis is a common associate and rachitis is occasionally observed with amyloid liver. Osler states that amyloid disease is found in prolonged convalescence.

Syphilitic inflammation of the liver in children is almost always congenital. In hydatid disease of the viscus we see a common cause at both periods of life, and as hydatids grow slowly, it is possible infection takes place in childhood, but symptoms do not arise until later in life.

In suppurative hepatitis the etiological factor differs at different ages. In this affection in children we do not find the baneful causative effects of high temperature, nor does it appear to follow amœbic dysentery as frequently as in adults. It is possible this form of dysentery is not common in children. The writer had occasion to analyze all the recorded cases of abscess of the liver up to 1890, and found that portal pyæmia and traumatism were more frequent causes than tropical dysentery (respectively 10 and 8 in 34 cases), and that round worms in the ducts were only slightly less common.

In cirrhosis of the liver, again, the causes are not dissimilar, although the infectious diseases play a more important part in childhood, while alcoholism is an infrequent causal agency. Klein points out the frequency of scarlatina, and Laure and Honorat, and Siredey, measles, as factors in its production. Tuberculosis is another cause. It is remarkable to find the affection occurring with general arterio-capillary fibrosis. Howard believed that rich, high-seasoned food is likely to produce cirrhosis in childhood, and that we have reason to believe ptomaïnes are causal agencies.

But little attention need be paid to the morbid anatomy and pathology of diseases of the liver in childhood. The morbid processes do not differ from similar processes in adults, and, as the scope of this article is limited, the discussion of morbid anatomy and pathological histology will be omitted.

General Symptomatology.—The subjective and objective symptoms of hepatic disease in childhood usually present the same striking picture of morbid change as in adult life. Apart from the symptoms that attend failing health, the subjective sensations of hepatic disorder are few. If we consider functional derangements of the liver to be the primary cause of lithæmia, then indeed the above remark is not correct; but, as previously noted, such relationship will not be considered.

Pain is a subjective symptom found only in one or two of the disorders which are to be discussed in this article. It occurs in suppurative hepatitis, in syphilitic inflammation of the liver when the capsule is involved, and in a slight degree in congestion. It may be localized to a small area, or

the whole organ may be the seat of pain. It is constant, increased by pressure or movement. It may extend to the right shoulder. The patient may be compelled to lie on the affected side with the legs drawn up. The paroxysmal pain that characterizes hepatic colic, and is the most frequent pain of hepatic disease in adults, does not occur. Pain in the region of the liver in childhood must be distinguished from pleurodynia and pleurisy. In pleurodynia there is immobility, respiration and other movements are painful, the area is tender on superficial examination by palpation, and other portions of the body may be affected with rheumatism, or there is a distinct history of exposure. In pleurisy the pain is markedly increased by breathing, is associated with a pleural friction, and is sharp and lancinating, attended by cough and increased by it. Pressure at a localized area increases it. It is often difficult, indeed impossible, to distinguish right-sided pleurisy from a perihepatitis. In both friction occurs; in the former, fluid may soon be detected in the pleural cavity, or the development of pneumonia may aid to distinguish the two. It may be said that the pain that attends liver disease is increased by pressure at any part of the liver, particularly upward along the lower edge of the viscus, or in the epigastrium.

Pain in simple abscess of the liver is localized; the locality corresponding to the seat of injury when that is the cause of the abscess. In pylephlebitis the pain is more diffused. In abscess there is localized tenderness; in perihepatitis the parts are exquisitely tender on palpation. Weight and fulness and uneasy sensations are described by the patient when there is enlargement of the liver. They are not of diagnostic value.

The subjective symptoms referable to gastro-intestinal derangement are many, but are not characteristic. Loss of appetite, a bitter taste, nausea, dyspeptic symptoms, particularly flatulency, with irregular or costive bowels, occur. The objective symptoms—noted by the usual methods of physical examination—are jaundice, ascites, enlargement of the spleen and of the abdominal veins, hæmorrhoids, and fever and sweats.

Physical Examination.—The liver in infancy and childhood is larger in proportion to the weight of the body than in adult life. It therefore presents a relatively greater surface for examination. The left lobe is particularly accessible to physical examination. The upper border of the liver extends to the fifth, sixth, and seventh ribs in the mid-clavicular, axillary, and scapular lines respectively. The lower border extends two inches below the margin of the ribs. In the median line the left lobe extends to within an inch of the umbilicus.

Inspection.—The decubitus of the patient is not peculiar in hepatic affections except when acute inflammation is present. The recumbent posture is assumed and the legs drawn up. The patient may lie on the right side. If pain be present, it is increased by keeping on the left side. The abdomen is usually distended by flatus, or in certain affections by ascites. If the liver be enlarged, the right lower third of the thorax is distended, as well as the contiguous portion of the abdomen. If there is much enlargement or if acute pain is present, the movement of the right lower half of the thorax is limited. The epigastrium is distended. The swelling of the hepatic area may correspond to the entire organ or may be localized. In abscess and hydatid disease tumors may be detected in the left lobe of the liver, along the lower border of the right lobe, or as swelling with projection of the ribs at points corresponding to the convex surface of the liver. Hence the epigastrium, the right hypochondrium, and right lumbar region, and the mid-clavicular, mid-axillary, and scapular lines along the upper border, are the favorite seats of election

of tumors. In abscess the superimposed skin may be reddened. The appearance of the veins over the surface must be noted.

Palpation.—By palpation the position of the lower border of the liver and the character of its surface are determined. The former is easily ascertained if the abdomen is not too much distended and if the child can be kept quiet during the examination. The normally large left lobe must not be mistaken for a tumor. The liver moves with respiration, and this fact must be ascertained in order to exclude the presence of tumors in the abdomen due to other causes. Fæces in the transverse colon must be excluded by the administration of purgatives. The surface of the liver, as well as its edge, may be soft, as in fatty liver, or indurated, as in amyloid disease. In both the edge is smooth; in cirrhosis it may be sharp, but is invariably hard. Bosses may be detected due to cancer, hydatid disease, or abscess. In hydatid disease they are soft and may fluctuate; in abscess they are hard at first, then become soft and fluctuating. A friction vibration is sometimes detected by the palpating hand in cases of perihepatitis, and the peculiar fremitus may be elicited in hydatid disease. Œdema of the surface is observed occasionally in abscess.

Percussion.—By this means the size of the liver, whether diminished or enlarged, can be accurately determined, and the degree of enlargement ascertained. Marked deviations from the normal boundaries of percussion, as indicated above, serve to distinguish the changes. It must not be forgotten that to define the upper border deep percussion must be employed, and, to define the lower border, light percussion. The colon must be emptied of fæces, and the character of the evacuations noted. Affections of the pleura, particularly effusions, must be excluded. When a pleural effusion is present there is a uniform bulging of the side, the respiratory movement of the liver is restricted, and a depression is sometimes seen between the effusion and the liver if that organ be pushed down. By percussion it is found that the dulness of effusion is movable, and that its upper limit is S-shaped or horizontal. The rational symptoms of pleurisy aid to distinguish it. When the liver is enlarged the ribs are everted.

In determining the outline of the liver by percussion it is well to ascertain if it be regular or not. When the liver is enlarged in its entirety the normal shape is not departed from. If the enlargement is due to hydatid disease or abscess, the outline is irregular. The area of dulness may extend out from the normal liver in positions indicated by palpation. Sometimes the enlargement, though uniform, occurs in one direction only; thus in abscess or hydatid disease of the convexity the increase in dulness is upward and to the right; in hydatid disease of the centre, downward. Both affections may be limited to the left lobe, and then an increase in size of the corresponding area is noted.

Diagnosis.—By means of physical examination, with a study of rational symptoms, simulated enlargement of the liver is excluded. Apparent increase in the size of the liver, as determined by palpation and percussion, may depend upon congenital change in the shape of the liver or upon displacement of this organ by the deformities of the chest, due to rickets or to caries of the vertebræ. Congenital change in shape is recognized by the fact that it is noted soon after birth, and that, while it is persistent, symptoms of hepatic disease are absent.

Apparent enlargement of the liver upward—dulness extending to the fourth rib in front—may be due to tumors in the abdomen or to ascites; or the normal liver dulness may be continuous with the dulness due to sarcoma of the kidney, to tuberculous disease of the omentum, to an ovarian tumor, or to encysted or free fluid in the peritoneal cavity.

If fluid be present, the dulness may change if the patient turns on the left side; the lower border can then be defined. If the fluid be encysted, diagnosis is more difficult. A history of previous peritonitis or a history of tuberculosis, with associated development of the disease in other organs, with fever and emaciation, is suggestive of tuberculosis, which is usually the cause of encysted fluid as well as omental disease. A tumor of the right kidney may be distinguished from an enlarged liver if the tumor be rounded, if the fingers can slip between the tumor and the liver, if a tympanitic note, indicating the presence of the intestine, be found to run across the surface of the kidney, if the tumor do not move with respiration, and finally by urinalysis.

The physical examination is not complete unless the characteristics of the organs adjacent to the liver are observed. Without such examination no diagnosis can be made nor rational treatment conducted.

Operative exploration of the liver, accomplished by means of the aspirator or hypodermic syringe, properly sterilized, is useful to confirm the diagnosis of hydatid disease or of abscess of the liver. By this means three kinds of liquid may be withdrawn—serum, pus, or hydatid fluid. The former, serum, does not occur in the liver; either the pleura or the space underneath the diaphragm yields it; but its presence does not exclude hepatic disease, for serous inflammation may complicate the liver affection. Cases are recorded in which, after emptying the pleura of serum, deeper exploration through the diaphragm yielded pus. The association of pleurisy or empyema and subdiaphragmatic abscess with hepatic disease must not be forgotten.

By the aspirator clear laudable pus may be withdrawn. It often contains crystals of leucin and tyrosin, and, it is said, the characteristic liver cells. If such cells can be recognized, it is proof positive that the pus was originally in the liver. The pus may be so mixed with blood as to appear reddish-brown, like anchovy sauce. In this case, on microscopical examination, the amœba dysenterica is sometimes found in the purulent fluid. The abscess is then secondary to dysentery.

Hydatid fluid is clear, alkaline, of low specific gravity, contains sugar, a trace of albumin, and a large amount of chloride of sodium. Succinic acid has also been detected. On microscopic examination hooklets, echinococcus membrane, sometimes scolices, and often hæmatoidin crystals are found. It is to be remembered that hydatid cysts may suppurate; pus will then be secured by aspiration, in which the remains of the echinococcus cyst are present.

In diseases of the liver in childhood an accurate diagnosis can be made only by a consideration of the personal history of the patient, of the previous diseases from which he suffered, of the evolution of the disease the nature of which is to be solved, the subjective symptoms and physical signs of the ailment, and the condition of all the organs and structures of the body. A systematic pursuit for all the facts, as embraced above, is necessary in the study of disease of any portion of the body; but the liver, more than other organs, is subjected to onslaughts of morbid action that primarily develop elsewhere; hence previous ailments must be investigated and the integrity of all the tissues carefully ascertained. For the differential diagnosis of the various affections this is essential. Of the hepatic affections discussed in this work, congenital disease of the gall-ducts, some forms of congestion, and hydatid disease are the only ones that are not secondary to affections of other organs.

A diagnosis is facilitated not only by inquiring into the integrity of the various organs of the body, but also by securing definite information regarding the occupation, habits, residence, and all other conditions of life of the patient. Illustrations could be advanced in any disease, but it suffices to

point out the value of the knowledge of alcoholism in cirrhosis, of exposure to phosphorus in yellow atrophy, of residence among dogs in hydatid disease.

Jaundice.

Etiology.—As seen most frequently in childhood, jaundice is due to obstruction of the bile-ducts—the *hepatogenous* form—resulting from pressure upon the ducts, or obstruction within them.

Pressure upon the Ducts.—Organic disease of structures adjacent to the ducts which might press upon them is very rare in childhood.

Obstruction within the Ducts.—Affections of the mucous membrane are abnormal processes very liable to occur in infancy. When the lining membrane of the ducts, and particularly the portion of the common duct known as the pars intestinalis, is the seat of catarrh, the membrane swells and causes obliteration of the lumen. Jaundice therefore occurs. Congenital obliteration of the ducts is also found to be a cause of jaundice. Gall-stones do not occur in childhood, and the wandering of worms into the duct is rare. It is seen, therefore, that the obstructive or hepatogenous form of jaundice is due in the larger proportion of cases to catarrh of the ducts and sometimes to obstruction of them by round-worms.

The causes of *hæmatogenous* or *non-obstructive* jaundice are also few in number. Yellow fever, malaria, epidemic jaundice, and pyæmia may be possible causal factors; poisoning by phosphorus, the use of ether or chloroform, mercurial poisoning, and snake-bite are rare possibilities. No cases of acute yellow atrophy in childhood have been reported.

Jaundice is a symptom, not a disease. It is recognized by symptoms and general physical signs.

Symptoms.—Icterus, or the yellow hue of skin in jaundice, is usually first noticed by the nurse or mother. The color varies from lemon-yellow to olive-green or a bronzed hue. In obliteration of the ducts it is most intense. It develops gradually, usually on the face first. In the obstructive form it is general. The conjunctivæ are deeply colored; the mucous membranes are tinted; the secretions are bile-tinged; the sweat stains the linen yellow. The urine is loaded with bile-pigment. It is brownish-yellow or has a greenish tinge. When shaken in a test-tube a yellow froth rises to the surface. By the nitrous acid test the play of colors characteristic of reaction with bile-pigment is seen. While the tissues and secretions are bile-tinged, the fæces are deprived of the pigment. They are pale or slate-gray in color, very offensive and pasty. The temperature is frequently subnormal. Prostration occurs, and anæmia arises. The influence of the bile on the nerve-centres or their peripheral terminations is seen in the character of the pulse, the occurrence of itching, and the grave cerebral phenomena to which the term cholesteræmia has been applied. The pulse-rate is much diminished; it often falls to two-thirds or one-half of the customary frequency. Itching is a most distressing symptom and is caused by the bile-pigment irritating the peripheral cutaneous nerve-filaments. Often the body, particularly the trunk, is covered with scratch-marks. The skin is liable to eruptions, as erythema and boils.

Ordinary cases of jaundice frequently show some irritability of temper and mental depression. This may be followed by drowsiness and by stupor ending in coma. In children convulsions are frequently seen. In malignant cases the typhoid state usually closes the scene; the pulse becomes rapid, fever occurs, the tongue is dry and brown, sordes collect on the teeth, and there is subsultus tendinum with low delirium, and sooner or later convulsions and coma.

Here too hæmorrhages occur, the leakage being subcutaneous or into the mucous membranes, and appearing as nose-bleed, hæmatemesis, or melæna.

Epidemic jaundice occurs at times in children. Denton reports a small epidemic among children of the same school. The symptoms were sudden vomiting, headache, vague gastric pains, with prostration, and in three or four days intense jaundice. Duration, ten to twelve days. Hennig, after a study of three house-epidemics of infectious icterus, concludes that it is a general acute, specific, infectious, miasmatic, non-contagious disease. It may be sporadic, epidemic or endemic, and appears to have a relation to typhoid fever and to typhus. The infectious agent arises outside of the human body. The disease runs a favorable course and never relapses.

Raven believes ordinary catarrhal jaundice may be infectious, and reports an instance in which one child of a family became icteric from exposure, and that four others of the house developed the affection, apparently by contagion.

Diagnosis.—The diagnosis of jaundice is not difficult. The greenish-yellow hue of chlorosis, with the pearly conjunctivæ, would suggest an examination of the blood, the result of which would distinguish chlorosis and jaundice. Similar examination would enable an exact diagnosis of pernicious (idiopathic) anæmia to be made in cases resembling jaundice in the straw-colored skin and the conjunctivæ made yellow by the deposition of fat. The rarity of Addison's disease in childhood is such as to preclude the possibility of an error in diagnosis. The same may be said of malignant disease of the abdominal viscera. Malaria, however, occurs at any age; but the rational symptoms, the plasmodia and pigment in the blood, and the condition of the spleen aid in the diagnosis of the paludal disorder.

Varieties of Jaundice.—Jaundice in the New-Born.—In the new-born infant jaundice occurs in mild form during the first week of life on account of ligation of the cord and consequent alteration of blood-pressure in the liver, and in malignant form in (1) congenital obliteration of the biliary passages, and (2) pylephlebitis secondary to inflammation of the umbilical vein.

Simple jaundice in infants rarely produces grave symptoms. The skin, the conjunctiva, and the mucous membranes show a yellow discoloration, varying in degree in different cases. The urine is loaded with bile-pigment. The child sleeps more than in health, and may not arouse when feeding should take place. The bowel movements may be pasty and white. Such jaundice begins twelve or twenty-four hours after birth. It lasts two days to a fortnight. The infant usually remains well nourished. It is due to low tension in the blood-vessels of the portal circulation (after ligature of the cord), which causes rapid absorption to take place from the bile-capillaries in which the tension is higher. Quincke thinks it is due to patency of the ductus venosus.

Icterus neonatorum is to be distinguished from the pseudo-jaundice that occurs after birth due to a destruction of red corpuscles in excess of the powers of the liver to discharge them from the body in the bile. In this condition the conjunctiva is not injected, the stools are not clay-colored, and the urine does not contain much pigment. The discoloration fades like a bruise from yellowish red to flesh color. It is said late ligature of the cord allows a portion (one-half) of the blood in the placenta to flow into the infant's body, and therefore this distends the fœtal vessels by so much. This fact is of importance if, as Parks states, distended blood-vessels exhibit more intense jaundice.

The treatment of the mild jaundice of infants is very simple. The bowels should be opened by a mild laxative, such as calomel or gray powder in minute

doses, or a few grains of calcined magnesia. The kidneys should be kept active by nitre or citrate of potassium well diluted. The child should be aroused to be fed, and the effects of the jaundice on the nerve-centres should be carefully watched. Ammonia in the form of the muriate or the aromatic spirits should be given, as in the following prescription:

℞. Ammon. chloridi . . . . . gr. j.
Syr. acaciæ . . . . . f℥ss.—M.
Sig. A coffee-spoonful every two hours.

Or,

℞. Spt. ammon. aromat. . . . . f℥j.
Syrupi . . . . . f℥vij.—M.
Sig. One-half teaspoonful every two hours.

Spirits in the form of whiskey in hot water may be given if there be depression. Hot water, sweetened, can be given with advantage in copious drafts, particularly when fasting, for its effect on the liver and kidneys.

There does not seem to be any reason against the use of gentle massage and faradism; both are vaunted in catarrhal jaundice in later life. Externally mild sinapisms, with light friction, must be employed if the circulation fails; and the extremities must be kept warm.

Jaundice due to Congenital Obliteration of the Bile-passages.—Four forms of obliteration have been noted: First, that in which no passage exists between the liver and duodenum; second, in which there is one permeable canal, but no exit from the gall-bladder; third, in which both cystic and hepatic ducts are obliterated; and, fourth, in which obliteration has taken place below the junction of the cystic and hepatic ducts.

Congenital malformation, with narrowing of the lumen of the parts on account of defective development, may exist to such degree that it leads to sluggish discharge of bile, which causes irritation of the ducts. A catarrhal process is set up, and leads to complete obliteration. The process is slow, but the obliteration is finished in some cases during intra-uterine life; in others not until a few months after birth. In a few cases the inflammation of the ducts and the surrounding parts has led to localized peritonitis. In all cases, "biliary" cirrhosis of the liver has developed secondarily.

The condition is rare. Dr. John Thomson was able to collect 64 cases. We are indebted to his monograph for the following facts: The parents of the children affected with obliteration of the bile-ducts are usually healthy. Syphilis in the parents is not an important factor. In several instances more than one child of the same family was affected, and in a large number of instances nearly all the children of families in which one case occurred had infantile jaundice or were subject to digestive disturbances. The character of the labor did not seem to influence the occurrence of the disease. At birth the affected child presented no abnormal appearance, except jaundice. In 2 out of 60 cases the lesions of congenital syphilis were seen. Boys were affected more frequently than girls.

Jaundice is the most pronounced symptom. It is most frequently present at birth, but may not develop until one, two, or six days after, and may be delayed beyond a fortnight. It soon becomes of a greenish hue, and it progressively deepens until the final termination. The urine contains bile coloring matter. The meconium may be normal or colorless. When it is normal the obliteration has taken place late in uterine life or not until after birth. The motions are whitish-gray at first or become so immediately after

the meconium is passed. At times green matter is voided with the stools. It may be due to mercury which had been administered or to micro-organisms in the fæces.

Next to jaundice, the occurrence of spontaneous hæmorrhages is the most frequent and characteristic symptom. They occur subcutaneously, from the umbilicus, the bowels, the stomach, the nose, and other portions of the body. The occurrence of hæmorrhage is of very bad prognostic omen, death usually occurring a short time afterward. Usually in jaundice the blood-corpuscles are so reduced as to create the hæmorrhagic tendency, but Thomson believes hæmorrhages occur because of some change in the blood-vessels produced by an excess of ptomaïnes in the blood, the function of the liver by which these poisonous materials are destroyed being in abeyance.

With or without hæmorrhage, convulsions frequently take place. These phenomena are of frequent occurrence in other forms of jaundice, and are not peculiar to the affection under consideration.

Progressive and easily recognized enlargement of the liver and spleen takes place, with the development of the grave phenomena indicated. Emaciation and exhaustion rapidly progress, and death ensues from slight intercurrent disease, from coma or from exhaustion.

The diagnosis is not difficult; the prognosis of a fatal termination is positive. The duration is from one week to four months. Two cases recorded by Thomson lived to the eighth month. Treatment is without curative results.

Jaundice due to Inflammation of Umbilical Vein.—Icterus may occur in infants because of inflammation of the umbilical vein, with secondary pylephlebitis. The stump of the cord is swollen and may exude pus, or the navel is ulcerated and inflamed. Hæmorrhage is likely to arise. The skin is discolored around the navel, and the parts are tender. The liver is enlarged, and may be tender over the surface. In rare cases a localized or general peritonitis occurs. The attack may be ushered in with a convulsion, which is apt to recur. The infant is restless and cries very much. The desire to nurse is lost. Vomiting occurs, and often diarrhœa soon sets in. Foci of infection arise in other structures—the joints, the brain, the lungs. The joints become painful on movement and are swollen and red.

After the convulsion, or perhaps without it, fever sets in with the customary phenomena. The temperature is high and may be intermitting; the pulse is very rapid, the respiration increased; cough may be present; jaundice is not very intense. As the temperature rises the liability to convulsions increases, and death follows the convulsions, occurs in coma, or may take place from exhaustion. After death a septic pleurisy, pericarditis, peritonitis, or meningitis may be found, or similar inflammation of the kidneys observed.

The fever, the local signs and symptoms, and the jaundice render the diagnosis easy. In a few cases the local signs are not noted, under which circumstances the difficulties are greater. The prognosis is most grave. The treatment is simply symptomatic. Prevention of this fatal illness of the new-born must be sought in strict antiseptic dressings of the cord. Often a cord bleeds after the first ligature. The second tying is most dangerous unless done with proper precautions. The writer had a case of this character in which infection took place from and at the hands of a dirty nurse. Before ligating the cord dirty rags were applied to attempt to control the hæmorrhage.

Jaundice in Winckel's Disease.—Jaundice is seen in that fatal affection of the new-born known as Winckel's disease, or acute hæmoglobinuria. Cyanosis and hæmorrhage occur with the hæmoglobinuria, but the liver and spleen do not enlarge.

Jaundice in Later Infancy and Childhood.—Icterus occurs at any period of childhood and in both sexes. It is usually of the so-called catarrhal form. Errors of diet, improper food, excesses, irregular meals, improper clothing, exposure and chilling of the extremities, leading first to gastro-intestinal catarrh, are common causes.

The onset is gradual, being preceded by the symptoms of acute or subacute catarrh of the stomach and duodenum. There is some tenderness in the epigastrium and the right hypochondriac region, the liver is enlarged and may extend an inch or two below the normal line, and the characteristic signs and symptoms of jaundice are present. The hue does not change to the green or bronzed yellow of malignant jaundice. Hæmorrhages do not often occur. A moderate degree of fever is observed for a short time. The course may extend over three or four months.

The diagnosis is not generally difficult. A history of long-continued improper feeding or of a sudden attack of vomiting, etc. from improper food or from cold, is usually elicited. The gradual development of the jaundice, with relatively slight constitutional symptoms, with moderate fever only, aids in the recognition of the character of the affection. The causal presence of worms or hydatid cysts in the ducts cannot be distinguished during life.

The prognosis is good.

Treatment.—If fever be present, rest in bed must be enjoined. The extremities must be kept warm. Mild counter-irritation over the epigastrium, by means of sinapism or frictions with stimulating liniments, may be employed; massage is also beneficial. Gerhard advises compression of the gall-bladder or gentle manipulation in that region. Faradism has also been advised. The diet must be bland and free from saccharine or amylaceous articles. Milk diluted with an alkaline or carbonated water or with lime-water and taken hot, koumyss if vomiting be present, junket, and animal broths, such as beef-tea, mutton-broth, and chicken-tea, may be administered. After the acute symptoms have subsided semi-solids may be used. Preparations of milk and eggs, beef-jellies, oyster-broth, and clam-broth are appetizing. Light fish may be selected as convalescence proceeds, and sweet-breads, broiled beefsteak, and the white meat of chicken.

If there be much gastric disturbance, sedatives must be used. Calomel in small doses, calomel and bismuth, effervescing alkaline waters, carbonic-acid water, citrate of potassium in officinal solution favorably made, are of service. If there be pain, minute doses of magnesia may be added to the mercurial powder, or paregoric may be given with the citrate of potassium:

℞. Liq. potassii citratis . . . . . f℥ij.
Tr. opii camph. . . . . f℥j.
Sig. One-half to one teaspoonful every two or three hours.

Hydrochlorate of cocaine in solution sometimes allays the vomiting. If there be constipation, an enema sufficient thoroughly to evacuate the bowels frequently relieves the vomiting. Afterward, if necessity requires, the bowels should be opened by a mercurial, as calomel or gray powder, in small, frequently-repeated doses, or by the citrate of magnesium, or a saline purgative, as Hunyadi, Friedrichshall, Bedford, or Saratoga water.

When the acute symptoms are ameliorated, it remains to treat the catarrhal inflammation of the duodenum and ducts and the symptoms due to the jaundice.

In the treatment of catarrh the diet, as indicated above, must be persisted in; small doses of bismuth may be continued. Nitrate of silver in small dose,

with opium if pain be present, is a valuable sedative which modifies the catarrhal process. In young children it may be given in solution and should be administered on an empty stomach:

℞. Argent. nitrat. . . . . gr. ss.
Mucilag. acaciæ . . . . . f℥ij.—M.
Sig. Teaspoonful three times daily to a child under two years.

Oxide of zinc, in doses of one-twelfth of a grain every three hours, is also useful.

Small doses of ipecacuanha are often, after acute symptoms have subsided, of service. One-fourth to one grain of the powder three times daily is praised highly by many.

Phosphate of sodium is a most valuable drug in catarrhal jaundice. Ten grains three times a day in milk for an infant or half-drachm to one drachm for a child of ten, in hot water, and taken fasting, proves of inestimable benefit. It may be used with other remedies.

Chloride of ammonium is much used, particularly in India; one to five grains of the drug every three hours is frequently followed by surprising results. It may be administered in syrup of licorice or in syrup of orange. It does appear to dissolve toughened mucus, to allay congestion, and to promote secretion from the glands in the tubes.

Pilocarpine in doses of one-sixteenth of a grain has been recommended. It seems to have been of great benefit to adults.

After the tongue cleans, or, as is often the case, its epithelium is restored and the papillæ assume a normal aspect, the sedative remedies may be discontinued and a weak bitter or an acidulated bitter may be given:

℞. Acid. hydrochlorici dil. . . . . ♏xxxij.
Infus. serpentariæ . . . . . f℥ij.—M.
Sig. Teaspoonful in water before meals.

For more chronic cases dilute nitric acid internally and the local pack of nitric acid are often serviceable.

If the jaundice be of malarial or gouty origin, quinine in the former, or colchicine in the latter, has been often prescribed.

Finally, to treat the catarrhal process, the method of Krull is strongly insisted upon: Two to four pints of water are injected into the colon two or three times daily. The temperature is raised at each enema. The first enema is given with the water at a temperature of 59° F. It is made two or three degrees warmer until enemata at temperature of 72° are given. Krull and others testify warmly to its beneficial effects in children. The writer has seen most surprising results in adults, and, as no harm can result from its use, would not hesitate to use it in children.

Of the symptoms of jaundice requiring especial attention, itching may be mentioned. Sponging with sedative lotions is of service. Ten drops of carbolic acid to a pint of water, a solution of the bichloride of mercury, 1 to 3000, hot solutions of alkalies, as bicarbonate of sodium or borax, a drachm of each to the pint, may be employed.

Pilocarpine is recommended by Goodhart. He preferred to give it hypodermatically; $\frac{1}{24}$ to $\frac{1}{32}$ of a grain should be given to children over four years old. Since it was advised by Goodhart a number of physicians have commended its use. Internal diaphoretics of domestic origin at times are of

service. An infusion of sage or hot drinks, with a stimulant, excite perspiration and relieve the itching.

Intestinal dyspepsia with flatulency and painful digestion require some medication. The diet should in a measure prevent the development of these symptoms; nevertheless, they occur. Preparations of pancreatin given an hour after meals, with an alkali, will aid much in digestion. If they are not of service, such drugs as correct fermentation in the intestines must be administered. Of these, salol, naphthalin, and thymol are of great service, while creasote, carbolic acid, and charcoal may be given with advantage. Salol may be administered in powder or compressed pill. Naphthalin and beta-naphthol should be given in gelatin-coated pill or capsule. The coating does not dissolve until the drug reaches the intestine, and hence is of great advantage. Creasote or carbolic acid may also be given in pill or in emulsion with syrup of acacia. A prescription like the following generally overcomes the disagreeable symptoms:

℞. Creasoti . . . . . gr. ¼.
Carbonis lig. . . . . gr. j.
Pancreatin . . . . . gr. j.
Bismuthi subnitrat. . . . . gr. iij.—M.
Ft. chart. No. i.
Sig. Take after meals.

Or,

℞. Acidi carbolici . . . . . gtt. iv.
Sodii bicarb. . . . . ʒj.
Spiritus chloroformi . . . . . fʒij.
Pulv. acaciæ . . . . . .
Sacchari albi . . . . . āā gr. xx.
Aquæ . . . . . q. s. ad fʒiij.—M.
Sig. A teaspoonful after meals or every three hours.

In selecting creasote the drug made from the beechwood must be used, and willow charcoal is preferable to the animal form.

The cerebral symptoms of jaundice can only be overcome by hastening the elimination of bile and at the same time supporting the patient. Stimulants must be used; preparations of ammonia, alcohol, and caffeine are to be selected. The preparations of ammonia are probably the best. Of course the patient must be nourished, and, if necessary, caffeine and cocaine may be resorted to. Both are advantageous stimulants, because they cause increased secretion from the kidneys, which are chiefly concerned in eliminating the bile. The poison without doubt sets up nephritis. It is necessary to guard against this complication if possible. Creating diaphoresis by jaborandi or the hot vapor-bath brings about this result. The kidneys may be relieved also by local applications, and particularly by the use of dry cups. In the case of more or less persistent jaundice these organs should be relieved quite frequently in the manner just suggested. The alkaline waters that may be selected for their beneficial effects upon the liver should also have diuretic properties. If they are not sufficient, the citrate of potassium or cream of tartar lemonade may be given.

The slow pulse, the subnormal temperature, and the prostration that ensues in jaundice are to be treated in accordance with the general principles of the management of these conditions. If hæmorrhages occur, turpentine or erigeron may be administered internally. Sulphuric acid and the acetate of lead are

also valuable astringents. The blood is always reduced in jaundice, the red corpuscles diminished in number. It is possible the systematic inhalation of oxygen may prevent this diminution, or at least combat symptoms depending upon it. It certainly is worthy of trial.

Congestion of the Liver.

Both the *active* and *passive* forms are seen. *Active congestion* is acute, and is induced by an exaggeration of all circumstances which increase the physiological congestion that takes place under the stimulus of food. Over-eating, the eating of rich food, the abuse of stimulants, are liable to cause an acute attack of hepatic congestion. Excess of heat may superinduce an attack in hot climates.

The symptoms are much like those of catarrhal jaundice, with the physical signs of enlargement of the liver. The jaundice is not intense. The face becomes sallow and cachectic if jaundice be absent. The patient loses in health and strength. Some pain is complained of in the hepatic region, which is tender on palpation. The liver is enlarged uniformly in all directions, often extending two inches beyond the normal boundaries; the edge can be felt and is smooth and rounded; the surfaces also are smooth. In a few cases the gall-bladder is enlarged, and can be detected in the right hypochondriac region to the left of the midclavicular line in a line drawn from the acromion process of the right shoulder to the umbilicus.

With the removal of the cause the symptoms disappear, and by the end of a month the functions of the gastro-intestinal tract are restored and the liver is reduced in size. In some cases enlargement of the organ and the peculiar complexion of the patient continue for a longer period.

Passive Congestion.—The passive form of congestion is associated with disease of the heart and lungs and chronic malarial poisoning. The pronounced symptoms are due to the disturbance of these organs; along with congestion in other organs the liver becomes engorged with blood, and hence gradually enlarges. The shape of the enlargement is similar to that in active congestion. The edge of the liver is likely to be sharper and more indurated. No nodules can be detected on the surface. In the right midclavicular line the lower border may extend to the level of the umbilicus, and in the median line the left lobe may extend three-fourths the distance. Frequently the upper border cannot be so readily made out, because of the occurrence of effusion into the right pleura. The rational symptoms are those of mild gastro-intestinal catarrh. The tongue is furred; there are nausea, loss of appetite, and intestinal dyspepsia; vomiting and constipation may occur, or there may be diarrhœa. A slight form of jaundice is developed. Albuminuria is observed, and the urine presents the appearance of congestion of the kidneys. On account of the interest centred in the condition of the heart and lungs passive congestion of the liver is frequently overlooked.

Diagnosis.—The diagnosis of active and passive congestion of the liver is made without difficulty. The presence of a cause for the congestion, together with the mode of onset, are pronounced factors in the diagnosis.

Prognosis.—In the acute forms the prognosis is generally favorable. In chronic congestion the prognosis is modified by the knowledge of the cause of the congestion.

Treatment.—The removal of the cause is essential to the successful management of active congestion of the liver. Correction of errors in diet, in habits of life, or in occupation often suffices to relieve the affection. The gastro-

intestinal symptoms are treated as in catarrhal jaundice. More stress must be laid on the use of purgatives for depletion. The alkaline waters and the mercurials are of benefit. Phosphate of sodium is useful; it may be given in hot solution on an empty stomach either at night or on rising in the morning. The hygienic and dietetic management employed in catarrhal jaundice is of use in active congestion of the liver. In hot climates, if such congestion occur, two drugs are used and lauded. The chloride of ammonium in 3- to 5-grain doses, every two or three hours, relieves the discomfort and appears to remove the engorgement of the organ. Ipecacuanha is used for a similar purpose. The drug must be given in large doses, administered twice in the twenty-four hours; 5 grains to children under five years of age is admissible. In order that vomiting should not be caused by the drug, the administration should be preceded by a few drops of the deodorized tincture of opium and a sinapism applied to the epigastrium. Twenty minutes after the application the drug may be given. After the more acute symptoms have subsided bitter tonics should be prescribed. If, however, there is pronounced gastric catarrh, small doses of calomel or bismuth or nitrate of silver, as advised in catarrhal jaundice, may be administered. One of the mineral acids, especially dilute nitric acid, in small doses, is given after the subsidence of the acute symptoms, particularly if the liver does not diminish in size.

Passive congestion of the liver is treated by alleviating the symptoms due to the engorgement, and by the employment of measures and remedies to relieve the primary cause of the disease.

Fatty Liver.

Enlargement of the liver due to fatty infiltration or degeneration occurs in the course of other diseases or on account of improper habits of the patient. In children it is always an intercurrent affection. Tuberculosis and wasting diseases generally are associated with fatty infiltration. The wasting that attends gastro-intestinal catarrh is associated with fatty liver. This is particularly the case if the catarrh results from the excessive use of sugar and starchy food. The enlargement is due to an accumulation of fat in the liver, and not to degeneration of the structures. It is said that children who are closely confined and have become anæmic are liable to this disease.

Symptoms.—The subjective symptoms are negative. Enlargement of the liver, which is uniform in all directions, is observed. The organ is of doughy consistency and the edge is rounded. The surface is smooth and painless on palpation. Jaundice, ascites, and other symptoms due to hepatic disorder do not occur.

Treatment.—The treatment depends upon the cause. If enlargement from fat accumulation is found in children who tend to be obese, and who have been indiscreet, strict hygienic and dietetic management must be invoked. The carbohydrates must be excluded from the diet; out-door exercise must be carefully planned, and if it cannot be indulged in, massage and Swedish movements must be directed. Sea-air has been advised in cases of this character.

Amyloid Disease of the Liver.

In this form of liver disease the organ is enlarged and but few hepatic symptoms of a subjective character are observed. The affection is associated with amyloid disease in the spleen, kidneys and intestines. The degeneration occurs in the course of phthisis, chronic bone disease, prolonged suppuration, and rickets. It may occur at any age throughout childhood.

Symptoms.—Anæmia is a prominent general symptom, and the pallor of the face is striking. The liver is enlarged in all directions; undue prominence of the abdomen in the course of any of the above-named affections should lead to an examination of this viscus. In addition to the enlargement of the liver, the spleen is also found to be enlarged. The liver sometimes attains a very large size; it may be twice or three times the normal weight. The surface is smooth, the edges hard and rounded. No pain attends palpation. The external veins may be distended; but jaundice does not occur, and ascites only results from diseases in other parts of the body, generally from the condition of the kidneys. Diarrhœa is usual, and hæmorrhage from the bowels may also take place.

Diagnosis.—The nature of enlarged liver occurring in the course of the diseases previously indicated can usually be determined without much difficulty. The diagnosis is rendered more positive by the detection of similar disease in the spleen and by the occurrence of albuminuria and polyuria due to amyloid disease of the kidney. The recognition of amyloid disease should be attempted in all cases in which operative measures for the relief of bone disease or suppuration is contemplated. Any grave operation will be contraindicated by the presence of this complication.

Treatment.—Notwithstanding the frequent suggestion by prominent authorities of the use of alkalies and the preparations of iodine in the treatment of this affection, there does not seem to be any drug which modifies or changes the course of the disease. The removal of the cause, if possible, is the most rational method of treatment. The few symptoms that are caused by the functional derangement or enlargement of the liver are to be treated. It must not be forgotten that in some cases it is almost impossible to say how much amyloid disease is present or to what extent the enlargement of the major organs within the abdomen is due to congestion. The symptoms and etiology may point with certainty to the presence of amyloid disease. If in such cases the heart be weak or there be organic disease, venous congestions of the viscera may also take place; and apparently hopeless amyloid disease may be cured by recognition of this pathological fact, and hence by resorting to removal of the cause by the administration of digitalis, strophanthus, and other heart-tonics.

Syphilitic Inflammation of the Liver.

The morbid process above indicated due to the special specific poison is seen in the congenital forms of the disease in childhood. Two forms of inflammation occur—one in which the disease is limited or in large part confined to the capsule; the second, in which the connective tissue of Glisson's capsule is the seat of inflammation.

Symptoms.—The symptoms are generally seen in children who have the characteristic appearance of face, trunk, and extremities of congenital syphilis, elsewhere described in this book. The skin eruptions, coryza and other mucous inflammations, anæmia, emaciation, and malnutrition, and, later in life, the appearance of the teeth, complexion, and shape of head, render the recognition of congenital syphilis comparatively easy. In perihepatitis there is much pain over the liver, breathing is difficult, and there is fever. The temperature rises to 100° or 101°, the pulse is frequent, the countenance distressed. Relief to the pain takes place when the patient assumes the upright position and crouches forward, or when he lies on his back with the legs drawn up. The marked tenderness interferes with palpation and

percussion. When the pain subsides the organ is found enlarged and the edges hard. After a week or ten days the more severe symptoms abate and convalescence is rapid unless the patient be broken down by previous bad health. Recurrence takes place on exposure or fatigue or without apparent cause.

In another group of cases the shrinking of new-made connective tissue begins, and soon the organ is grasped in the toils of fibroid overgrowth, contraction takes place, and all the symptoms of portal obstruction arise.

Jaundice may be the only manifestation of infantile hepatic syphilis. It is in all probability due to perihepatitis, with compression of the gall-duct, or to enlarged glands, which likewise compress it, or, most frequently, to adhesive inflammation of the portal vein.

Syphilis may be the cause of cirrhosis of the liver. The symptoms are twofold—one due to the congenital taint with possible associated lesions in other structures; the other, to portal obstruction. The latter symptoms do not differ from those of portal obstruction in cirrhosis of the liver of alcoholic origin.

Diagnosis.—The diagnosis of syphilitic disease of the liver is determined largely by the association of the lesions and well-known appearances of congenital syphilis, with symptoms indicating inflammation and functional disorder of the liver. Often the symptoms, and particularly the objective ones, are not obvious. The apparent alteration in size of the liver is not demonstrable; there is little if any pain, and features of portal obstruction are not observed. Jaundice may be the only symptom present. It is well to bear in mind that persistent jaundice in childhood without apparent cause, certainly if the gastro-intestinal tract be free from catarrh, may be of syphilitic origin. The therapeutic test often aids in making a diagnosis.

Treatment.—The treatment is largely that of the cause, the remedies applied for the relief of congenital syphilis being indicated. In addition to the constitutional treatment the pain, jaundice, ascites, and other symptoms are to be relieved by methods previously indicated in this paper.

Suppurative Hepatitis.

Two varieties are seen. In one the abscess is single, and in the other multiple; in the former the suppuration in nearly all the cases is secondary to trauma; in the latter suppurative pylephlebitis has occurred on account of suppuration in the portal area.

Symptoms.—The symptoms in the two forms differ entirely. In traumatic abscess, after the injury there is much pain in the hepatic region and symptoms of perihepatitis. The parts about the seat of injury are swollen, and the external surface may show the signs of a blow. After the injury the pain may diminish and the child be apparently well, when a recurrence of the local symptoms will arise; or the effects of the injury may not subside in the usual time. Pain in the region of the liver will be complained of, and on examination the organ is found to be enlarged. The enlargement is not uniform. It may be upward only, or, as is most frequently the case, be indicated by extension of the lower border of dulness downward. On palpation the hepatic region is painful; œdema over the most painful part or over the hepatic area or the area of enlargement may be observed. If the abscess be developing in the right or left lobe, an undue prominence may be seen in the right hypochondriac or in the epigastric regions respectively. It will be noted to move with respiration and to be continuous with liver dulness on percussion.

With the development of the local signs of enlargement and inflammation general symptoms arise. The fever, which may have been due to trauma, does not disappear, and indeed becomes more pronounced. It assumes a remittent or even distinctly intermittent type, and may be preceded by daily rigors and followed by exhaustive sweats; prostration ensues, and there may be a loss of flesh. The tongue is furred, appetite lost, vomiting may occur, and diarrhœa is frequently present. If the inflammation be seated on the convex surface of the liver, breathing is interfered with and cough may be present; both respiratory acts will in all probability be attended with pain. The pain is then noted in the sixth or seventh interspace in front or the seventh or eighth interspace behind. It may extend to the right shoulder, and in some cases pain in this position alone is complained of.

As previously intimated, sometimes the symptoms of suppuration, with local signs of inflammation, do not develop until a long time has elapsed after the injury. The general symptoms may arise before local signs of inflammation are evident. Between the injury and the development of the symptoms the child is not in good health. Loss of appetite, languor, inability to exert himself as was his former habit, with loss of flesh and strength, are very likely to be present.

Multiple abscess of the liver is usually preceded by a history of suppuration, and therefore a point of infection somewhere in the portal area. An appendicitis is one of the most frequent affections which precede this form of suppuration. It is thus seen that active abdominal symptoms may be present prior to the development of symptoms indicating involvement of the liver. If in the course of such symptoms jaundice arises and the liver becomes enlarged and painful, we may well suspect that the inflammation has spread to the portal vein. The type of the fever may also change. It becomes distinctly intermittent, and daily chills attend it. The onset of jaundice is characterized not only by the discoloration of the skin, but by the development of symptoms of the typhoid state. Delirium of a low muttering character soon occurs, deepening into stupor. The tongue becomes dry and brown, sordes collect about the teeth and lips, and subsultus is seen. In some instances convulsions occur; in others death takes place from exhaustion. Diarrhœa, if not previously present, is sure to arise. The stools are offensive and watery, and contain light-colored fæcal matter. The urine contains bile-pigment, soon becomes scanty and high-colored, and is found to contain albumin and to have blood, epithelial, and granular casts. The nephritis may become so marked as to be a serious, indeed fatal, complication.

The patient usually lies on the right side, and when he assumes the opposite position complains of a heavy, dragging sensation. The skin is sallow, the complexion muddy. The facies is quite characteristic. Waring describes the appearance as follows: Countenance expressive of anxiety, shrunk, collapsed, pale, livid, or parchment-like.

Diagnosis.—If the symptoms of suppuration just indicated arise after trauma or the occurrence of suppuration of the portal area, diagnosis is not difficult. The cases of suppuration secondary to worms in the hepatic duct, or to suppurative inflammation of the ducts, extremely rare in childhood, are recognized with difficulty. The absence of a focus of suppuration in any other portion of the body when hectic symptoms are present should determine the necessity of careful examination of the liver. Enlargement, either general or local, may be made out by careful percussion. The exploratory needle may render positive a suspicion of hepatic suppuration, but the negative results of puncture do not exclude abscess. Friction-sound at the base of the right

lung, with diminished expansion of that side, may call attention to possible hepatic suppuration.

Reference has not been made to abscess of the liver occurring in the course of dysentery. The writer has not been able to find any recorded cases of this association in childhood, though there is no special reason why it should not occur. In cases of dysentery it is important to interrogate as to the condition of the liver, and, on the other hand, in acute liver affections the presence or absence of dysentery is to be ascertained. Amœbæ in the stools, in pus from an abscess, or in expectoration would confirm the diagnosis of this form of abscess of the liver.

Prognosis.—In multiple abscess of the liver the prognosis is very grave, such cases terminating fatally. In single abscess, if the pus can be reached by aspiration or by the knife, the prognosis is much more favorable. If the abscess be beneath the diaphragm in the upper portion of the right lobe, the issue is much more doubtful than when superficial.

Treatment.—The management of a case falls entirely into the hands of the surgeon. In multiple abscess of the liver no measures are of avail. In single abscess or where the number is limited to three, free incision must be made and may result favorably. If the abscess be situated along the margin of the ribs or in the epigastric region, the operation is simple and reparation takes place rapidly. The writer has seen two such cases recently in the Philadelphia Hospital. An abscess of the convexity of the right lobe must be reached through the pleural cavity. Excision of the ribs is necessary, and isolation of the pleural cavity quite essential. After pus is secured and the cavity drained and irrigated, a drainage-tube must be inserted and the case treated by the usual surgical methods. Recently the writer reported a case under his care in which Dr. Willard performed the operation above indicated most successfully.

Hydatid Disease.

This is a comparatively rare affection in this country. It seems, however, to be on the increase; within the last two years the writer has seen six cases, and knows it to have been more common in the experience of others. In children it is even more rare than in adults. With the exception of a child under twelve at the University clinic, no cases have come under the writer's observation. In the literature of the disease few if any cases are reported under two years of age. The liver is one of the organs most frequently affected. In childhood it appears to be the organ selected in 70 per cent. of the cases. In the recent exhaustive work of Graham a few cases only are recorded. He states that within a period of one year he observed hydatids in ten children, their ages varying from five to eight years. The youngest case that he refers to is one operated on by Thomas, a boy aged two years and one month. This disproves the statement of Leuckart, who at the time of his publication believed the youngest cases recorded to have been four and six years of age respectively.

There is, therefore, no immunity for children if their associations are such as to cause infection. The infection may occur very early in life, but the slow growth of the cyst makes it possible that they are not recognized for years. Moreover, in childhood, as Graham remarks, "the organs in which the cysts are situated are less likely to be so completely affected as is the case in the adult subject where the pressure changes are more permanent."

Space will not permit a discussion of the mode of development or infection of the human species. The growth in the child and the manner of its infec-

tion do not differ from the same in adults (for description of which recent text-books on pathology contain sufficient information).

Symptoms.—The cyst in the liver may develop and reach a large size without recognition. Attention is first called to its presence by the occurrence of mechanical symptoms; the abdomen enlarges or there are enlargement and swelling of the liver region. On examination, if the liver be the seat of the disease, it is found to be enlarged. The enlargement may be uniform; usually, however, it takes place in a particular direction. If the growth springs from the convex surface of the liver, the area of dulness extends higher in the axillary region and behind in the scapular line. If it begins in the right lobe, and the lower portion thereof particularly, the extent of dulness is increased downward toward the umbilicus. Sometimes the tumor is confined to the left lobe of the liver, and hence is recognized in the epigastric region. The prominence in the epigastric region or below the ribs in the mammary line is smooth and tense on palpation; sometimes fluctuation can be detected. In a moderate proportion of cases the so-called hydatid fremitus is elicited, if the left hand be placed over the tumor and another portion tapped quickly and forcibly with the right.

The tumor is painless, and there is no tenderness on pressure. The patient suffers from distention. There is interference with respiration, so that frequently he is compelled to sit up in bed in order to alleviate the dyspnœa. The general health is usually unaffected.

In some cases the cyst is in such relation to the hepatic duct as to cause compression jaundice. The jaundice usually develops gradually. In rare cases the cyst breaks into the hepatic duct; some pain follows this accident, and on account of the obstruction by the cystic contents jaundice develops. If the patient comes under observation after rupture of the cyst has taken place, the diagnosis is rendered more obscure. The enlarged cyst has been dispersed, and therefore most of the signs of tumor disappear.

Suppuration of the cyst sometimes takes place, and in addition to the symptoms due to hepatic pressure those of pyæmia arise,—rigors, periodical elevations of temperature, sweats, and great prostration. Jaundice occurs either because of the pyæmia, or, if it be intense, because of obstruction of the ducts and probably suppurative cholangitis.

The outcome of cases of hydatid disease varies. The liability to rupture is the same at all periods of life; perforation may take place into the stomach, the colon, the pleura and bronchi, or in some cases externally. It has been said that in a few cases where this accident has occurred recovery has taken place. The perforation may also take place into the pericardium or the vena cava; when this accident occurs death takes place suddenly.

Diagnosis.—A diagnosis is not usually difficult. Irregular enlargement of the liver, the surface of which is smooth and painless, or the presence of a tumor of the same character connected with the liver, probably fluctuating, in an individual otherwise in good health, usually indicates the presence of this disease. If the cysts are multiple, and the surface of the tumor, therefore, irregular, the diagnosis is more difficult. The health is usually retained, and the benign nature of the enlargement thus inferred. Syphilitic disease of the liver and carcinoma must be excluded in adults. The rarity of the latter affection in childhood and the absence of a primary focus of malignant disease, with retention of health and strength, exclude cancer. In syphilis the enlargement of the liver may be irregular and a distinct boss recognizable. This usually occurs in tertiary syphilis, a form not seen in childhood. In congenital syphilis involving the liver large prominences are not seen. Nevertheless, in both

instances it is well to resort to exploratory puncture, and, if syphilis be suspected, to the treatment as a test in diagnosis. If suppuration takes place in the cyst, it cannot be distinguished from abscess unless it be known before the accident that there was a painless enlargement of the liver without fever. In adults dilatation of the gall-bladder has been mistaken for hydatid. This condition does not occur in childhood, and hence need not be considered. Hydronephrosis has also been mistaken for hydatid disease. The condition is not common in children, but can be distinguished by the results of exploratory puncture. When the cyst extends upward, it is often difficult to distinguish it from a pleural effusion. The same physical signs in the lower part of the right chest may be present as in effusion. Frehrichs believed that the direction of the upper line of dulness is significant in hydatid disease of the liver. It does not take the S curve, as in effusions, but reaches the highest point at the angle of the scapula. Sometimes empyema complicates a hydatid cyst, as in cases reported by Murchison. The cases that are most difficult of diagnosis are those which have ruptured into the lungs before coming under observation. The appearance of hooklets in the sputum is characteristic.

Reference has been made in the beginning of this article to results of exploratory puncture in cases of suspected hydatid disease. The fluid withdrawn has special properties which render the recognition of the disease absolute.

Prognosis.—From results of observation at the post-mortem table we see that a number of cases of hydatid disease of the liver undergo spontaneous cure. These cases, of course, are not recognized during life. If the disease is recognized and the tumor is accessible, the prognosis is very good. The results of treatment are generally quite favorable.

Treatment.—Internal medication is of no avail and need not be discussed. Surgical procedures are necessary. Electrolysis has been used, but since the advent of antiseptic surgery has fallen into disuse. Medicated injections are not in high favor. Iodine, carbolic acid, solution of bichloride of mercury, and permanganate of potassium have been used, but the treatment is open to objections. Indeed, at the present time all methods except free incision are discarded as more or less dangerous. The uncertainty that attends the introduction of the trocar and the possibility of infection render such methods more or less hazardous, while the difficulty of completely emptying the cyst renders it liable to recur after the fluid is withdrawn. Recamier's method of opening into the cyst by caustics or the thermo-cautery has been employed. The method is tedious and painful, and not without danger.

The treatment by direct incision and evacuation of the contents of the cyst has been rendered possible by the developments of abdominal surgery. Incision should be made over the most prominent part of the tumor in the manner of performance of a laparotomy. After the cyst is exposed it should be attached to the edges of the abdominal incision; it is then opened by the knife and its contents evacuated. The daughter-cysts may be evacuated by forceps. Too much force must not be used. In order to secure complete evacuation irrigation of the cyst-cavity must be employed. A drainage-tube is then inserted and the patient dressed as in an abdominal operation. If the cyst grows from the upper surface of the liver, it must be evacuated by passing through the diaphragm. One or two ribs should be resected, the pleura stitched to the diaphragm, and evacuation then brought about by the previous method.

In cases that have been operated upon a form of urticaria known as the *hydatid rash* is sometimes seen. It is said that the fluid of a hydatid cyst

will not cause peritonitis. Any portions of the cyst-wall that are left behind or any of the daughter-cysts will cause suppuration.

Cirrhosis of the Liver.

Through the writings of Palmer Howard, of Edwards, of Hatfield, and others we have learned that in its etiology, clinical course, and mode of termination cirrhosis of the liver in childhood does not differ from that in adult life.

Etiology.—Alcoholism is a very constant factor in its causation. The habit is usually fostered because of the delicate state of the child in early infancy, coupled with the belief of ignorant parents that rum contributes to its development. It is true some children from their swaddling-clothes have an appetite for liquor, and when not discouraged are likely to develop all the lesions of alcoholism. Syphilis, as already mentioned, is another prominent cause. In Howard's cases an adhesive pylephlebitis took place primarily, followed by secondary cirrhosis. In some of the recorded cases chronic heart disease was the causal factor. The infectious fevers, as scarlatina and measles, play an important part. Tuberculosis is attended by a form of cirrhosis both when the liver is involved in the tuberculous disease and independently of it. Howard and others believe that ptomaïnes and products of imperfect digestion may be productive of this affection. In rickets there is often found enlargement of the liver which is due to an overgrowth of connective tissue.

Hypertrophic or biliary cirrhosis is rarely seen in childhood. It is due to chronic obstruction of the biliary passages, and hence is present in congenital obliteration of the ducts.

From the recorded cases collected by the above-mentioned authors, cirrhosis of the liver has been found to occur more frequently in males than in females in the proportion of two to one. The largest number of cases occur between the ninth and thirteenth years. It is found, however, at birth, and may occur at any period subsequently.

Symptoms.—In the early stages of the disease capillary congestion is noted in the face. This may increase. As the disease advances the face becomes drawn, the parts free from stigmata are pale, or a sallow, muddy complexion is seen. The symptoms due to obstruction are usually most prominent. Gastro-intestinal catarrh is observed. Morning nausea and retching with discharge of mucus take place, the appetite is poor, the bowels irregular, alternating attacks of diarrhœa and constipation take place, and the bowel movements usually contain considerable mucus. Hæmorrhages from the lower end of the œsophagus, the stomach, or the intestinal tract may occur, and are very characteristic symptoms of cirrhosis. In gastric hæmorrhage the vomiting has no relation to food, and is not associated with symptoms of gastric ulcer. In the later stages of the disease hæmorrhages occur from the nose or the mouth, and purpuric spots develop. They are due to the state of the blood. Hæmorrhoids are frequently present.

Jaundice occurs in about the same degree of frequency as in the cases of adults. It is usually slight, and may disappear and recur two or three times in the course of the disease. Slight fever is seen in many cases. The temperature rises to 101° and 102° in the evening. It may be present for a long period of time, and as the end approaches disappear entirely.

The urine is high-colored, of high specific gravity, and contains an excess of urates and uric acid. Frequently nephritis develops in the course of the affection. Albumin is then found, and the urine contains hyaline and granular casts. The specific gravity always remains high, and there is an excess of

lithates. From time to time sugar may be detected, but a persistent glycosuria is not likely to arise.

On physical examination, when the disease is somewhat advanced, further evidences of portal obstruction and attempts at compensatory circulation are seen. The venules along the base of the thorax, extending across the chest in an arc, following the attachment of the diaphragm, are very distinct. The external veins, particularly the epigastric and mammary, are particularly distinct. If compensation does not take place, ascites develops, and after its development the feet may swell. The spleen is frequently enlarged, but its size often cannot be determined when ascites is present. The liver is found to be enlarged if the case is seen in the early stage, and it may be slightly tender on palpation. Subsequently it diminishes in size, or the small size is at once noted. The diminution of the left lobe is particularly noticeable. With the walls relaxed the edge and surface can sometimes be felt rough and granular. Some cases are not attended by atrophy. Thus there may be much fat in the liver, and, notwithstanding the connective-tissue overgrowth, the organ remains enlarged. Fatty atrophy of the liver is the name applied to this form. In "biliary cirrhosis" the liver is enlarged and smooth. Jaundice is permanent, and the other symptoms of cirrhosis are present.

On account of the organic disease of the liver auto-intoxication takes place with ptomaïnes or products of imperfect digestion. Low delirium, deepening into stupor, with the ocurrence of frequent convulsions, or noisy delirium followed by convulsions, show the effect of the toxine on the nervous system. Jaundice is not necessarily present when these symptoms develop.

Diagnosis.—The disease may be far advanced, and not recognized because of the absence of symptoms or signs. A boy aged fifteen years died in the Presbyterian Hospital of typhoid fever. He had been under the observation of the writer for nine years. Acute rheumatic fever with endopericarditis was the reason of the first consultation; valvular disease continued. The patient had been in poor health, and the parents were wont to give him spirits. This had been continued more or less until the fatal illness occurred. At the autopsy cirrhosis of the liver in an advanced degree was discovered.

The appearance of the face, the symptoms of portal obstruction, and the physical signs of atrophied liver are points on which the diagnosis is based.

The occurrence of subacute gastritis with morning vomiting, of hæmatemesis, and of malæna, without the physical signs of a small liver, are nevertheless most suggestive, particularly if the patient be poorly nourished, with a drawn, pallid countenance, and especially congestion of the cheeks—venous stigmata. If ascites, enlargement of the spleen, and jaundice supervene, the diagnosis is absolute.

Treatment.—We can never tell whether the enlarged liver of the early stage of cirrhosis is one in which congestion predominates, or, on the other hand, one in which the overgrowth of connective tissue is in excess. If the former, we know that there are measures which markedly influence the engorgement. If the latter, it is possible a further increase may be averted by proper hygienic and prophylactic measures. It is our duty, notwithstanding the uncertainty, to relieve engorgement. External depletion by cups and leeches, purgatives in quantity to ensure three to six liquid stools a day, Rochelle salts, citrate of magnesium, and saline waters, are to be used. The waters of such springs as Saratoga and Bedford in this country, and Carlsbad in Germany, are beneficial. Counter-irritation in mild degree is likewise of value. If leeches or cups are inadvisable, stimulating liniments may be employed. The diet is to be carefully selected. A milk diet is for a time the most satisfactory.

Stimulants and rich, stimulating articles of food, fats, sugars, and starches are to be avoided. Waters are to be used abundantly; they may be taken hot in large bulk (a glassful) when the patient is fasting to flush the liver.

Phosphate of sodium may be advantageously added to waters to produce a depurative effect. At first small doses of calomel or mercury with chalk should be given for a few days. A furred tongue, nausea, constipation, with pasty stools, indicate its use. From time to time it should be repeated. Iodide of potassium has been said to relieve the engorged liver in the early stage of cirrhosis, but the chloride of ammonium is a better drug, in doses of five to ten grains in syrup of licorice or in emulsion, given every four hours.

The treatment of the second stage is entirely symptomatic. Gastro-intestinal catarrh, hæmorrhages, ascites, jaundice with its resulting phenomena, and finally the distressing symptoms of the cirrhotic cachexia, require in turn, or too frequently at the same time, careful therapeutic and dietetic management.

Whatsoever the symptoms may be, the diet plays a most important part. The class of food referred to above is to be selected; from time to time a strict course of milk diet may be instituted. Again, with the ascites most prominent, a dry diet should be advised. The condition of the stomach and bowels very largely determines the character of diet. If there be much intestinal dyspepsia, albuminoid food should be administered. Meats chopped fine and made into a pulp can be given for a long period of time. In order to create free discharge of the products of digestion, large quantities of water should be taken once or twice a day. The disadvantage of a continuous meat diet arises in the possible development of scurvy. This may be counteracted by the use of lemon-juice once or twice in twenty-four hours. The gastro-intestinal catarrh is treated by the same class of remedies as are indicated and have already been detailed in the management of catarrhal jaundice.

Hæmorrhage from the stomach is to be treated by rest, the use of cracked ice, the external application of the ice-bag, the administration of food by the rectum, and the use of astringents. An opiate should always be given to quiet the agitated patient. Morphine hypodermatically or dry on the tongue may be selected, or the deodorized tincture of opium combined with the chosen astringents used. Gallic acid is one of the preferable astringents; aromatic sulphuric acid may also be employed. Both should be given well diluted in iced water:

℞. Tr. opii deodorat. . . . . .
Acid. sulphuric. aromat. . . . . āā f℥j.—M.
Sig. Eight to ten drops every two, three, or four hours, well diluted.

The acetate of lead alone or with bismuth is a valuable astringent. Hamamelis may be given in the form of the fluid extract well diluted; twenty drops is a sufficient dose, and may be given every one or two hours to a child of ten. Astringent preparations of iron usually are advised—the sulphate, the chloride, and the pernitrate. They should be given in small doses frequently repeated. If nausea and vomiting are not present, ergot might be used; the writer, however, has never had any benefit from its use; indeed, gallic acid and the aromatic sulphuric acid have been sufficient to control the bleeding. Intestinal hæmorrhage may be treated by astringents by the mouth or by enemata. If bleeding be from the rectum or the lower portion of the colon, weak solutions of alum or of salts of iron by enema are of special value. The solution should be cold if the bleeding is from hæmorrhoids. One-half drachm of Monsel's solution to three ounces of water are the proper propor-

tions for enemata of this character. Ice may be used in the rectum, as well as ice-water. By the mouth the astringents advised for gastric hæmorrhage can be used. It is best to administer them in such form that they will be dissolved in the intestine; a one-grain pill of Monsel's salt may be given every half hour or hour. The pill should be hard. Acetate of lead in pill may also be given. In this class of cases aromatic sulphuric acid has been sufficient in the writer's experience. Turpentine has been advised by competent authorities, and may be given in capsule in doses of two or three drops every two hours. The oil of erigeron is also considered to be a valuable styptic.

If the ascites be not too great or of too long standing, it may be removed by dry diet and diuretics. Alkaline diuretics are particularly of service. Cream-of-tartar lemonade and infusion of scoparius are excellent diuretics. Saline waters which act on the kidneys and the bowels are of great service. Gentle catharsis may be maintained without fear of exhaustion if salines be used. On account of the tendency to intestinal catarrh, irritating cathartics should not be employed. At times the effusion seems to come to a standstill; the bowels have been sluggish, and the internal viscera apparently loaded with stagnated blood from passive congestion. A brisk cathartic often relieves engorgement and starts up absorption of the exuded fluid. In children the compound jalap powder is the best of the class. It should be given in doses of twenty grains; the amount may be increased if necessary. If the simple diuretics and cathartics are of no avail, four measures are to be considered and may be tried:

1st. The use of calomel with diuretics, as in the well-known pill of calomel, digitalis, and squills. It may be given in accordance with the following formula:

℞. Hydrarg. chlorid. mit. . . . . gr. $\frac{1}{16}$.
Pulv. digitalis . . . . . gr. $\frac{1}{4}$.
Pulv. scillæ . . . . . gr. $\frac{1}{4}$.—M.
Ft. pil. No. i.
Sig. To be taken every three hours.

After this combination is administered for ten days it should be withdrawn and squills and digitalis given alone. It then may be resorted to again, the frequency of its use depending upon the effect of calomel on the bowels.

2d. Caffeine is a valuable diuretic, particularly if stimulating effects are desirable. Dose 1 to 3 grains to a child under ten. The hydrochlorate of cocaine is another drug of the same class, and seems to have been of service.

3d. Copaiba. This is a most valuable drug in ascites. Its diuretic effect is decisive and usually permanent; it is to be given in capsule; three minims is sufficient for a child, to be taken every four hours.

4th. Paracentesis. Paracentesis should be employed early and frequently, if after a short trial the remedies above indicated do not lessen the amount of effusion. No hesitancy should arise on account of danger, as no accidents or complications are likely to occur. A number of cases have been reported in which frequent tapping has cured the ascites, and thereby arrested for a time at least the progress of the hepatic disease.

The treatment of jaundice need not require further consideration, for it has been discussed fully in a previous portion of this article. The symptoms of the cirrhotic cachexia which ensue in the latter stages of this malady are alleviated by careful nursing, attention in detail to diet, and the administra-

tion of remedies which secure full functional activity of the various organs of the economy. This particularly applies to the circulation. Cardiac tonics are indicated. Stimulants should not be withheld, and now are of service to counteract prostration, aid digestion, and increase the strength of the heart and circulation. All measures that can be invoked to relieve exhaustion, improve anæmia, and aid nutrition should be resorted to. The administration of concentrated food—animal broths, meat extracts, etc.; the inhalation of oxygen; the use of stimulating baths and lotions; measures to prevent the development of bed-sores,—each or all may be used as indications demand. Proper clothing, in order that the extremities and abdomen may be kept warm, must be insisted upon. At this stage multiple hæmorrhages and purpura are liable to ensue. The internal administration of astringents, but more particularly of turpentine, or the oil of erigeron, appears to check their development.

PERITONITIS; TUMORS OF THE PERITONEUM AND OMENTUM; AND ASCITES.

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I. Acute Peritonitis.

This affection is an acute inflammation of the serous membrane lining the abdominal cavity and covering the abdominal viscera. It is characterized by a tendency to effusion, by adhesions through coagulable lymph, and by the deposition of purulent or sero-purulent fluid. Such an inflammation may be confined to a portion of the membrane, when it is said to be circumscribed or local, or it may involve the whole surface of the peritoneum, and thus become general. At the onset only will it be circumscribed or limited, for, unless checked, it quickly manifests a disposition to extend over the whole of the inner surface of the peritoneal sac.

Etiology.—Peritonitis may occur during intra-uterine life, in the new-born, and during infancy and childhood. In early life idiopathic peritonitis is not a very frequent disease, since at this period the peritoneum is not so susceptible to inflammation as the serous membranes of the thoracic and cranial cavities. When it occurs during intra-uterine life, it is always traceable to syphilis in the parents. It may cause the death of the fœtus in utero, or the child may be born suffering from the disease or its consequences. So far as is known, no symptoms in the mother serve to indicate the existence of peritonitis in the fœtus. If it be not fatal before birth, the resulting adhesions are very apt to interfere with the development of the intestines or to cause a constriction of a portion of the bowel.

In the new-born, acute peritonitis is most frequently the result of septic or pyæmic processes. It is usually caused by an unhealthy inflammation of the umbilicus or by the absorption of septic matter at that point. (See Diseases of the New-born.)

In infancy and childhood an attack may be traced to exposure to wet and cold. Thus, wetting and chilling of the feet, damp beds, chilly winds, sudden alterations of temperature, rapid cooling of the heated body, and excessive fatigue may be enumerated under this head as causes of acute peritonitis, just as they may act in the production of inflammation in other structures. Very often traumatism may serve as the exciting cause, and here may be enumerated contusions, direct blows upon the abdomen, and the wounds of cutting or blunt instruments produced accidentally or surgically, as in paracentesis abdominis. Again, various mechanical causes (which are in reality traumatic in their nature) may operate in its production, such as intestinal invagination, strangulated hernia, displacements of some of the internal organs, or laceration or unusual stretching of the peritoneal membrane. In like manner, peritonitis

may be caused by the extrusion of foreign matters into the serous cavity, as in ruptured hepatic or splenic abscess, rupture or perforation of the stomach, bile-ducts, spleen, uterus, urinary bladder, ureters, or some part of the intestines. It may follow or accompany acute disease of some organ by contiguity of structure; and here may be mentioned gastritis, splenitis, hepatitis, dysentery, ulcerations in typhoid fever, and ulcerations of the vermiform appendix, appendicitis, and the like. Numerous instances have been encountered where an empyema perforating the diaphragm has set up acute peritonitis; and this result has been observed even in the absence of perforation, the lymphatics acting as the channel of communication. In girls purulent vulvo-vaginitis has frequently caused acute peritonitis by an extension of the inflammation through the uterus and Fallopian tubes. At times also it may result from pressure and ulcerative absorption caused by tumors and malignant growths. The sudden retrocession of a cutaneous eruption has sometimes been closely followed by an attack of peritonitis, and it is on record that lumbricoid worms have penetrated the bowel and thus acted as an exciting cause.

Finally, it may occur as a complication of, or a sequel to, rheumatism, erysipelas, pernicious intermittent fever, and the various exanthemata.

It has been quite well established that in the development of peritonitis micro-organisms, rendered operative by any of the before-mentioned local disturbances, must be regarded as the essential causes. When, experimentally, non-pathogenic microbes, even when combined with small amounts of chemical irritants, are injected into the peritoneal sac, purulent peritonitis is not produced, but only a serous inflammation. On the other hand, when pathogenic micro-organisms are introduced even in very small quantities, severe fibrino-purulent peritonitis ensues. The micro-organisms which produce peritonitis are those found in pus, the staphylococcus, and the streptococcus. Before they can increase in number a preceding or accompanying change in the peritonuem is necessary. If the absorptive powers of the peritoneum be greatly changed, the microbes will effect a putrefaction of the intraperitoneal fluids, and as a consequence will produce a general putrid infection of the whole system.

Pathological Anatomy.—The transparent and shining appearance of the membrane is lost. This is accompanied by a diminution of the lubricating secretion, rendering the serous membrane less moist. The subperitoneal vessels become turgid with blood, are visible through the thin membrane as an interlacing network, and when they are greatly distended the peritoneum presents a velvety appearance. At times the blood exudes through the coats of the vessels, when puncta or plaques of sanguineous effusion are seen. Later, if the disease progresses, the serous secretion is increased in quantity and altered in character, being composed of liquid serum and a more solid or glutinous material known as coagulable lymph. It may happen, however, that the effusion is entirely composed of serum; or, on the other hand, serum may be altogether absent. In metastatic peritonitis or in attacks of asthenic character the effusion may be puriform or distinctly purulent, while in sthenic cases the deposit of lymph may vary from a very thin layer to a thickness of several lines, and it is usually of a yellowish color. When abundant, it may be found in layers, smooth or corrugated, or it may exist as bands of adhesion uniting the viscera with each other or with the parietal peritoneum. At first villous in appearance, it afterward becomes smooth and denser, and finally assumes a structure similar to true peritoneal membrane. When once formed, plastic lymph acts as an irritant to the serous surfaces with which it may come in contact—a fact which serves to explain how inflammation is so apt to be diffused over the entire

peritoneal surface. When health is restored these bands of adhesion may partly or entirely disappear. If they continue they may cause little inconvenience, though it may happen that, by their topographical relations, they may interfere with the functions of the organs to which they adhere. In children the effusion is most commonly purulent; it may be merely puriform, decidedly purulent, or simply sanious. Ulceration may occur through the abdominal walls or through the diaphragm into the lung or bronchi, or again through the digestive tract, the bladder, the vagina, or through the psoas muscle, permitting pus to escape from the peritoneal cavity by one of these various channels.

When peritonitis exists as a sequel to scarlet fever, measles, rheumatism, or other fever, the serous fluid is in excess, whilst the plastic lymph is inconsiderable in amount or nearly absent. The results of an attack, while at times causative of further disease, may in other cases be protective against more serious accidents: adhesions may supervene which will seriously interfere with the functions of the organs or parts which are bound down or united by these bands; on the other hand, as in some cases of perforation, this same inclination to plastic exudation may be conservative of life, the deposit being a means by which nature seeks to effect reparation.

Symptoms.—The earliest and most pronounced symptom of peritonitis is pain. At first the area of pain may be limited; afterward it will extend over the whole abdomen. The pain is accompanied by high fever and decided constitutional disturbances, such as rigors and general malaise. Pressure over the abdomen and augmented action of the abdominal muscles, as in deep inspirations, coughing, sneezing, expectoration, and the like, will aggravate the pain. The lightest weight cannot be borne upon the abdomen; hence the little patient assumes a position which will relax the abdominal walls as much as possible, and lies quietly on his back with his knees bent and thighs flexed. The belly is hot, rounded, and tense, almost invariably swollen and tympanitic from accumulation of flatus due to paralysis of the muscular coat of the intestines. Sometimes flatus may be readily passed per anum, at others not; and in this case symptoms of intestinal obstruction are simulated. The bowels are usually constipated, though diarrhœa is occasionally met with. Vomiting is nearly always present from beginning to end, and is aggravated whenever food is taken, until the presence of bile and fæcal matter in the ejecta may be almost suggestive of some mechanical bowel obstruction.

The skin is hot and dry; the temperature, as a rule, is elevated, ranging from 101° to 105° F., but it becomes subnormal if the attack terminates in collapse. Inflammation of the peritoneum, however, may coexist with a normal or subnormal temperature, and this very frequently happens in the purulent cases. The pulse is small, feeble, rapid, and wiry. The respirations are accelerated, short, incomplete, and jerky, and are costal in type, the abdominal wall remaining motionless. The tongue is coated and the breath is foul. The face is expressive of great suffering and anxiety, and when the attack is very severe, the alæ of the nose are drawn upward, the nostrils are dilated, and the lips are parted, so as to expose the teeth, producing the expression known as risus sardonicus. The urine is scanty and high-colored, and often contains albumin.

When the attack is to terminate in recovery all these symptoms gradually diminish in intensity, whilst the countenance, which has been so truthful an exponent of the patient's condition, once more becomes placid and natural. If the attack is to eventuate in death, the pulse becomes quicker and more thready, the general surface cold and clammy, the extremities chilled, and the breathing

shallower and more rapid, until life goes out from failure of the general vital forces. In a few cases incoherency of speech or active delirium is present toward the end, but most generally the mind remains clear and logical to the last. The fatal issue of an attack may take place in two or three days, though frequently the patient may live until the sixth, seventh, or eighth day.

Diagnosis.—Peritonitis in its severer forms is readily recognized, but when subacute or circumscribed, or when it is secondary or exists as a complication, it is not so easy of diagnosis. In young children it is especially difficult to determine its presence because of the uncertainty of exact localization of pain. In erratic cases also pain may be absent, and thus we will be hampered in diagnosis. The diseases simulating acute peritonitis are gastritis, enteritis, colic, rheumatism, neuralgia, renal calculus, and lead-poisoning. The diagnosis must depend upon the severity of the symptoms, special attention having been paid to the history of the case. If there be persistent vomiting of all fluids and solids, with the presence of sharp paroxysmal pain, accompanied by tenderness on pressure upon the abdomen, with cessation of the abdominal respiratory movements, a frequent, wiry pulse, and fever, the diagnosis of acute peritonitis may be made with reasonable certainty.

Prognosis.—In the generalized form prognosis is always grave. It has been said that there is no more fatal disease, recovery taking place in rare cases only. The more pronounced the symptoms are, the more doubtful will be the prospect of recovery; and if the patient shall have passed into the stage of collapse, a fatal termination is usually to be expected. An acute peritonitis which is metastatic in origin or which is due to perforation is generally fatal. Diarrhœa is of evil portent, and constant vomiting with complete obstruction of the bowels is a very grave symptom.

Although the general prospects of recovery are so slight, yet patients apparently moribund have been known to get well. The attack may last but a few days, or even only from thirty-six to forty-eight hours, and very rarely indeed longer than a week.

Treatment.—The cause of the attack will determine the treatment to be followed in a given case. Unfortunately, however, the physician will not always be in a position to know accurately what this may be or what exact anatomical lesions may exist. The patient must be confined absolutely to bed. All food and drink must be stopped, only cracked ice or iced water to moisten the mouth being permitted. This interdiction of all ingesta must be imperative, in order to avoid the harassing and painful vomiting. Nutrition can be maintained until the cessation of vomiting by the use of enemata or suppositories containing appropriate substances, as broth, milk, egg-albumin, stimulants; later, when the vomiting shall have been overcome, the food should be limited to twelve or fifteen ounces (best predigested) per diem. Ice pills may be given to control the vomiting, also iced champagne in small doses frequently repeated, as well to soothe the feeble stomach as for its stimulating effects. Locally, various remedies have been employed. Soft flannel cloths saturated in a solution of tincture of iodine in castor oil and applied over the belly have been highly recommended. Local bloodletting by the application of from four to twelve leeches to the surface of the abdomen is often very valuable in the initial stage. The inunction of mercurial ointment to the abdomen was formerly much in vogue. Stupes, made by steeping flannels in a pint of hot water containing ten to twenty drops of spirits of turpentine and sprinkled with laudanum, are often of great service. Light flaxseed-meal poultices, dashed with oil of turpentine or laudanum and laid upon the abdomen, have in my hands been of great value. Care should be taken that the poultices be

not too hot, lest the integument be burned. By some physicians cold applications, such as the ice-bag or cold-water coil, are preferred, but children almost always resist their use.

As to the methods of internal treatment—whether by saline purgatives or by opium—a difference of opinion still exists among physicians of equal skill and eminence. It will be safe to abide by the following conclusion: When an attack of acute peritonitis is recognized almost at the moment of its inception, salines by their rapid and complete depletion may abort an attack. The peritoneum will be drained of the products of inflammation, the formation of bands and adhesions will be prevented in consequence of the increased peristaltic action of the bowels, whilst, clinically, pain will be relieved as quickly as by the administration of opium. On the other hand, if the case is not seen by the physician until some hours after the commencement of the attack, and especially if grave doubts exist as to the cause of the disease, opium and external methods of depletion must be used. It need scarcely be said that in perforative peritonitis the purgative treatment must not be thought of at all.

In case it has been decided to administer a purgative, either a seidlitz powder or some other mild saline or calomel is to be preferred for children. When opium is to be given—which should always be the case when there is intense pain, tenderness, constant vomiting, and a distended and paralyzed condition of the bowels—it should be given in quantity sufficient to relieve pain, to reduce the frequency of the pulse and respiration (the latter to about twelve movements per minute), and to make the little patient slightly drowsy. Two to five minims of the deodorized tincture of opium, or one to four grains of Dover's powder, may be given every four hours, according to indications, at the age of six years. The effects of the opium must, of course, be narrowly watched, for, as is well known, children are very susceptible to its action. In older children morphine may be given either per orem or by hypodermatic injection in doses of from one-twelfth to one-sixth of a grain. The tincture of belladonna is frequently combined with the opium. Excessive tympany can be relieved by the use of laxative enemata in which spirits of turpentine or tincture of asafœtida has been suspended; or, in case of their failure, the long rectal tube may be used. Free stimulation must be resorted to early, and such alcoholics as brandy, whiskey, and champagne are to be preferred. To these may be added, to assist in keeping active a flagging circulation, such cardiac stimulants as sparteine, strophanthus, and digitalis; these, if vomited, must be given by the rectum or under the skin. Later, when the attack promises to terminate favorably, every effort must be made to build up the system and to increase nutrition by the exhibition of tonics and easily-assimilated, nourishing food.

As soon as the diagnosis of acute peritonitis has been made, the question of opening and draining the peritoneal cavity will present itself. Here, again, differences of opinion are encountered. Some advocate an early and immediate operation, whilst others claim that, as cases recover without operation, it is better not to risk the added dangers of surgical interference. It may be considered proper to operate in the following forms of peritonitis: First, in the fulminating forms of the disease, which are characterized by a rapid advance of the symptoms, excessive vomiting and tympanites, feeble pulse, and great restlessness. Secondly, in cases in which collapse seems imminent in spite of treatment, and which present a decreasing temperature and a rapid pulse constantly growing feebler. Thirdly, in cases in which pus is present in the abdominal cavity, or in which a tumor is located in, or adjacent to, the abdomen. Fourthly, in cases in which the peritonitis is the result of perforation or ulceration of any of the abdominal viscera. And fifthly, when the peritonitis is

due to intestinal obstruction. In older children the chances of success are greater than in the younger ones. A certain number of cases will be met with in which the diagnosis will be questionable. It will, at times, be doubtful whether the exudation be purulent or composed only of lymph, and whether the inflammation has been general from the first, or has spread from the cæcum or other localized inflammatory area. In such cases it is held to be justifiable to perform an exploratory operation, which may, under some circumstances, be the means of saving the patient's life. To discuss the method of operation and the questions of drainage and irrigation is not embraced in the scope of this article, and for such details the reader is referred to the works on operative surgery.

II. Chronic Peritonitis.

As a chronic affection peritonitis, with the exception of the tubercular variety, is rare. As early as 1838, Wolff published a study upon chronic peritonitis, and stated it to be an extremely common affection in children; but as all of his one hundred cases were reported cured, it seems likely that a large proportion were incorrectly diagnosticated. Since then until quite lately the subject has received but little consideration at the hands of medical writers, and the opinion has gained ground that all chronic peritonitis, almost without exception, is tubercular (West). This view, however, has been considerably modified by the more recent studies of Baginsky, Vierordt, Henoch, and others, and it is now accepted that the peritoneum, just as well as the pleura, may be the seat of a simple chronic inflammation with serous exudation.

Chronic peritonitis may sometimes be the sequel of an acute attack of the disease, but it is more frequently an independent affection.

Etiology.—Most of the patients are females—a fact that suggests a possible connection in some cases between the peritoneal inflammation and a vulvo-vaginitis, which is by no means uncommon in little girls. Rarely a history of traumatism may be elicited, as in a case reported by Henoch, confirmed by post-mortem after a course of six weeks. In another group of cases a preceding exanthem may be the apparent etiological factor, as seemed to be likely in two cases—one observed by Fiedler, and the other by Henoch—both occurring after measles. The complete cure, after several tappings, in Henoch's case leaves little doubt of its true character.

Symptoms.—The symptoms of non-tubercular chronic peritonitis are rather obscure. The abdominal pain is apt to be slight, whilst the constitutional symptoms are variable. Usually the health fails gradually; the appetite becomes capricious; there is alternate diarrhœa and constipation, the former of which may or may not be accompanied by pain; sleep is disturbed, and the skin is hot and dry at night. Subsequently, pain or a sensation of tightness in the abdomen is complained of, and after a time effusion of fluid takes place, fluctuation may be discovered on examination, and the cutaneous veins are turgid and well defined. The pain now becomes more marked; it is usually not localized, but shifts about from one spot to another; generally there is tenderness on pressure over the abdomen; still, the appetite may be fairly good, the tongue tolerably clean, and the bowels not particularly irregular. As the effusion accumulates dyspnœa appears; the pulse is accelerated; evening and morning exacerbations of temperature are observed; the child rapidly loses strength, becomes much emaciated from profuse diarrhœa, and eventually dies of exhaustion. Yet cases presenting all the symptoms of chronic peritonitis have been known to recover, the effused fluid and other products of inflammation being gradually removed by absorption.

Diagnosis.—When ascites is the only symptom, it will be necessary to differentiate between an effusion due to simple chronic peritonitis and one caused by obstruction to the portal circulation. The latter condition is comparatively rare in childhood, whether it be due to cirrhosis of the liver or adherent pericardium and mediastinitis; and the chances are immensely in favor of the presence of a chronic peritonitis. The ascites due to cardiac disease can be eliminated by careful examination of the heart. Since, in the beginning of the disease, the symptoms simulate those of chronic intestinal catarrh, one must be careful to distinguish between this affection and chronic peritonitis.

The differential diagnosis between chronic and tubercular peritonitis will very often be impossible. The point of greatest value, however, is the general state of the patient: in the simple form the general nutrition and well-being of the child suffer but little as long as digestion is not greatly disturbed nor the effusion overwhelming; while in the tubercular variety the early emaciation is striking. Search for bacilli in the effusion, even in tubercular cases, is often disappointing, and hence a negative finding does not exclude the more serious disease.

Prognosis.—This must be guarded, for, while most cases are decidedly unpromising, a certain proportion recover. The history and progress of a given case must give us the cue.

Treatment.—As the disease usually begins with an intestinal catarrh, our treatment must be directed toward that condition. The child must be placed under the best hygienic surroundings. Plenty of sunlight and, when possible, country air or a sojourn at the seashore, are to be insisted upon. The clothing should be carefully regulated to meet the exigencies of the case, the weather, and other external conditions; and a flannel bandage must be constantly worn about the abdomen. The patient should be kept at rest, and it is a good plan, in the warm weather, to wheel his couch into the open air as often as possible.

The diet should be bland, but nutritious. Moderate quantities of underdone chops or steak, fish, fowl, and eggs are all allowable; so also are milk and cream if they do not disagree, but starchy foods are better avoided.

Abdominal pain may be relieved by hot opium fomentations or inunctions of belladonna ointment; when these fail or in protracted cases, blisters or stimulating liniments, tincture of iodine, compound iodine ointment, and iodide of potassium ointment are useful applications. Frequently in these cases the application to the abdomen of a mild mercurial preparation, such as an ointment of the yellow oxide of mercury, about twenty grains to the ounce, will do good service.

In the way of medicines the mineral acids and preparations of pepsin are useful as aids to gastric digestion; and to combat the intestinal catarrh, bismuth, sulpho-carbolate of zinc, the bitter vegetable tonics, and alkalies should be administered.

The internal use of iodine is also beneficial. This may be administered in the form of iodide of potassium in guarded doses, which must be discontinued on the first indication of disordered digestion; but a preferable form is the syrup of the iodide of iron, in doses of from five to thirty drops, according to the age and tolerance of the patient, several times daily. I usually order it to be given in cod-liver oil, which is convenient and efficacious.

If the ascitic effusion shows no tendency to disappear by absorption, tapping by means of a very small trocar and canula should be resorted to, the fluid being allowed to drain away very slowly. It has been advised that during the first few weeks the fluid be drawn off once in twenty-four hours, the amount varying in quantity from one to two pints; then every two, every three days,

and, finally, once a week. Gradual improvement, it is said, usually takes place under this treatment. When the disease has defied every method of treatment, especially if the fluid returns quickly after repeated tappings, permanent drainage of the peritoneal cavity has been recommended. If pus be present, incision and drainage should be practised. Recently cœliotomy and washing out of the peritoneal cavity have been advocated by some surgeons as a routine treatment. In some instances it may even be justifiable to perform an exploratory operation. However, in those chronic cases in which the symptoms are not urgent and the child is not failing, it will be the part of wisdom and prudence not to interfere surgically, but to wait on nature's efforts, supplemented by medical measures, to effect a restoration to health.

III. Tumors of the Peritoneum and Omentum.

Tumors of the peritoneum and omentum, though rare in children, are occasionally met with.

Carcinoma of the peritoneum has been encountered in early childhood and even in fœtal life. It may be primary, and then is often congenital, but it is much more commonly secondary. Scirrhus is the usual variety, and generally occurs in diffused nodules. The primary form is difficult to detect; the secondary, much less so, because its presence will be suspected when symptoms referable to the peritoneal cavity occur in the course of cancerous invasion of some other portion of the body.

Sarcoma of the peritoneum has also been met with in childhood, but it is of very rare occurrence. This variety of neoplasm may grow to such an extent as to involve the omentum, mesentery, and other parts in addition to the peritoneum; in fact, both carcinomatous and sarcomatous growths are apt to involve both peritoneum and omentum.

Lipomata may also grow from the peritoneum. They are encapsulated, and have no connection with any other organ.

Serous cystic tumors of the peritoneum also occur. These cysts are composed of pseudo-membrane, which during their evolution and organization includes a portion of the fluid exudation and receives an internal serous investment; they are attached to the peritoneum either by means of a thin neck or by a broad base. Cystic tumors of the peritoneum are difficult to detect, and must be differentiated from cysts of the omentum, from cysts of the various abdominal viscera, and from ascites.

Tumors of the omentum are quite rare in early life. Omental cancer is usually of the colloid variety, and it may grow to an enormous size. Carcinoma, however, is seldom limited to the omentum, the peritoneum being usually involved simultaneously. Again, when scirrhus invades the peritoneum the omentum usually suffers from the same disease. Cysts and hydatid tumors of the omentum are met with in children, the former not infrequently. The cysts are usually dermoid in nature, though simple serous cysts are encountered. Both varieties, but especially the dermoid, may suppurate.

Symptoms of all varieties of tumors, whether involving the omentum or the peritoneum, or both, are rather vague, particularly in their incipiency. Later, when they have grown larger, the so-called pressure-symptoms develop and aid us in making a diagnosis. Even then it is very difficult to make a correct differential diagnosis, the pressure-symptoms chiefly aiding in locating the site of the tumor, without throwing light upon its character.

Cancer of the peritoneum and omentum produces the signs of a diffuse, more or less acute peritonitis with effusion, the so-called cancerous peritonitis.

In the earlier stages of the disease the patient will complain of paroxysmal pain, which later will be more persistent. Lipomata are attended by no special symptoms beyond the growth of a painless tumor. Growths confined to the omentum are movable and occasion no functional disturbance of the intestines. In cystic tumors, either of the omentum or peritoneum, the abdomen is apt to be enlarged; if the tumor be superficial, it will be movable on palpation and give signs of fluctuation, which must be distinguished from the fluctuation of ascites. If the patient live long enough and the growth attain the proper size, true ascites will supervene. Pain, of course, will be most prominent in the cases of cancerous tumors. In time, whatever may be the nature of the tumor, but particularly in the cases of carcinoma, the general system suffers, nutrition is impaired, the patient is easily fatigued, his appetite fails, and, if the growth cannot be removed, a cachectic condition develops which at last terminates in death.

Prognosis is most favorable in cystic tumors, less so in lipomatous and hydatid growths, and fatal in the carcinomatous.

Treatment of cancerous tumors consists mainly of palliation of symptoms. Anodynes and opiates to control the pain are indicated, and, if the ascites become burdensome, paracentesis is to be performed. Attention to the general condition of the patient, sustaining his strength with good food and tonics, together with the observance of well-established hygienic principles, will embrace all that can be done for these unfortunate sufferers. Operative measures are not to be advised in these cases.

Operation, cœliotomy, has been more successful in cases of sarcoma, lipoma, hydatid growths, and particularly in cystic tumors. Cystic tumors may be excised or they may be aspirated and drained. As drained cysts are apt to refill, the radical operation, excision, is to be preferred, and it must always be resorted to when suppuration takes place.

The proper treatment for pressure-symptoms will be suggested by their characters in individual cases.

IV. Ascites.

Ascites is an accumulation of fluid—usually serous—within the peritoneal cavity; occasionally chylous ascites occurs, but in children this variety is extremely rare. Essentially considered, ascites is not a disease. It is a symptom of either general dropsy or some local disease of the abdominal viscera, and consists of a transudation of liquid into the peritoneal cavity in consequence of disturbed circulation in the liver or of pressure exerted upon some portion of the portal circulatory system.

Etiology.—The most common cause of ascites in children is cirrhosis of the liver, which, in turn, is most frequently due to syphilis. It may also arise from a simple osmosis of the watery constituents of the blood, in which case it is but a local expression of a general hydræmia superinduced by some cachexia, and it is then often associated with hydrothorax or general anasarca. Again, it may result mechanically from an obstruction to the venous circulation caused by cardiac, pulmonary, or peritoneal disease. Neoplasms of the abdominal cavity, whether malignant or benign, and particularly lymphatic tumors situated in the hilum of the liver, will also cause it by mechanical interference with the circulation in the viscera.

Bright's disease and acute nephritis; organic heart disease; atelectasis pulmonum and emphysema; enlargement of the spleen and profound anæmia caused by malarial poisoning; the pressure of lardaceous lymph-glands upon

the portal vein and inferior cava; and occasionally chronic tubercular peritonitis, which interferes with the circulation in the peritoneum,—are other etiological factors. Interstitial nephritis is not so apt to cause an ascites as a general anasarca. Benign tumors in the abdominal cavity are exceptionally accompanied by ascites, malignant tumors constantly.

Pathology.—The pathology of ascites is comprehended in the lesions involved in the primary affection. The changes in the peritoneum itself are slight and inconstant. Sometimes this membrane has simply a reddened appearance, but not infrequently it is pale and devoid of any signs of inflammation.

Symptoms.—The constitutional disturbance attending the formation of an abdominal effusion usually passes unnoticed, but it may be ushered in with chilliness, nausea, headache, vomiting, colicky pain, or a brief, intermitting diarrhœa. Pain is absent unless the effusion is caused by peritonitis. When effusion has reached a certain point, the tenseness of the abdominal walls is apt to cause indigestion and irregularity of the bowels; the skin becomes dry and has an ashen or clayey look; and the navel protrudes and may be encircled by a plexus of dilated veins, termed "caput Medusæ." In very large effusions the skin of the abdomen becomes stretched and glistening, and at times fine white striæ, similar to those which are observed upon the abdomen of a pregnant woman, make their appearance. The character of the pulse depends upon the primary disease; still, it is generally feeble and easily compressed. Provided no inflammatory disease coexists, the temperature is normal. The urine is variable in quantity, though usually diminished; then it is high in color, and may contain albumin and fibrinous casts. As a result of mechanical interference with the return circulation from the lower extremities ascites is very frequently attended by œdema of the feet and ankles. Large effusions, crowding against the liver, spleen, and kidneys, and forcing the diaphragm up to the second and third ribs, cause anæmia of these organs and collapse of the base of the lungs, with consequent general anasarca.

Finally, painful and difficult micturition or incontinence of urine, together with difficulty in evacuating the bowels, will ensue. The constant crowding upward of the diaphragm and liver causes dyspnœa, hydrothorax supervenes, and at last the child, unable longer to assume a horizontal position, dies either from asthenia or asphyxia.

Physical Examination.—Palpation and percussion reveal fluctuation indicative of the presence of fluid, which varies in position according to the posture assumed by the patient. Thus, whilst standing, the abdomen is largest in its lowest part; when prone it spreads laterally, and if the patient be turned on either side it falls toward the more dependent. In any of these positions percussion practised over the uppermost part of the abdomen, to which the gas-containing intestines always float if entirely free to move, gives a clear tympanitic note, and by successively altering the patient's posture the tympany readily moves from point to point, while the dulness due to the fluid also changes its place. Wave-like fluctuation is another valuable sign.

Diagnosis.—The diagnosis of ascites is comparatively easy, yet it must not be forgotten that in children other conditions are often encountered which produce an enlargement of the abdomen. Naturally, the smaller the effusion the more difficult is it to make a diagnosis. When the abdomen is distended by a sufficiently large amount of fluid, wave-like fluctuation and movable dulness can readily be obtained, and leave no doubt of the diagnosis. Small effusions, although always obscure, are most readily detected when the patient sits or lies on one side.

In addition to detecting the presence of ascites, it is necessary to determine

the nature of the antecedent disease, as upon this prognosis depends. When the fluid is large in amount and movable, atrophic cirrhosis of the liver may be suspected. If the effusion be small and immovable and loculated, the cause is most probably tubercular peritonitis. This disease is characterized by the presence of disseminated nodules, and its symptoms are tenderness upon pressure, pain, and fever, possibly conjoined with indications of tubercular disease in some other organ.

Prognosis.—Though not always a hopeless condition, the prognosis is not very encouraging. Provided the primary cause upon which the ascites depends be removable, as in malaria or alcoholism, and the liver is not completely invaded by the disease, we may hope, by removal of that cause and by proper treatment and hygiene, to effect a cure of the abdominal dropsy.

Treatment.—In the milder degrees of ascites treatment consists in the administration of diuretics, diaphoretics, and hydragogue cathartics. Acetate of potassium, combined with digitalis and compound spirit of juniper, acts favorably. A very efficient combination is the following:

℞. Magnesii sulphat. . . . . .
Potassii bitartrat. . . . . *āā* ℥ss.
Aquæ cinnamomi . . . . . f℥iii.—M.
Sig. A tablespoonful every three or four hours, according to its effect upon the bowels.

When great general anasarca coexists with the ascites, threatening interference with respiration and circulation, in addition to the free purgation hot vapor baths are to be recommended. These may be applied in the following manner: The patient, completely divested of clothing, is laid upon a blanket, and immediately several bricks, which have been in the mean time thoroughly heated by immersion in pails of hot water, and then enveloped in flannel cloths, are placed at the shoulders and feet. Care must be taken that they be neither too hot nor put too near the body, lest the skin be scorched. Another blanket is then thrown over the patient. The upper corners of the superimposed blanket are brought over and tucked under the opposite shoulders, while the other end of the upper blanket, with the lower end of the underlying one, are lapped together under the heels of the patient, and the head alone is left to protrude from this improvised sack. This hot pack is maintained for at least twenty minutes, producing profuse diaphoresis and usually greatly ameliorating the symptoms. The patient and his friends are apt to complain loudly of this heroic treatment, but I can recollect several instances where by its use the child was saved from imminent death; and often it will accomplish the end sought when all other measures have failed.

A strict milk diet is to be enjoined as a rule. When, however, hydræmia is prominent, iron, tonics, nutritious food, and good air, with a proper observance of all recognized hygienic rules, are indicated. In ascites depending upon atrophic hepatic cirrhosis squills, digitalis, calomel, and iodide of potassium will be of service. In this variety, however, the ordinary diuretics usually have but little effect. Here Basham's iron mixture is highly spoken of—viz.:

℞. Tinct. ferri chlorid. . . . . .
Acid. acetic. dil. . . . . *āā* f℥j.
Liq. ammonii acetat. . . . . f℥vi.
Aquæ . . . . . q. s. ad f℥vj.—M.
Sig. Tablespoonful three times daily for a child of six years.

If, despite this treatment, the fluid continues to accumulate, paracentesis abdominis must be practised. This operation should not be performed too soon, nor should we delay it to the last moment. The proper time is when remedies fail after a fair trial and when, in spite of treatment, the patient's general health daily deteriorates. Ordinarily this operation is simple and free from danger. Either an aspirator or fine trocar and canula may be used, but I prefer the latter. This tapping can be repeated as often as the exigencies of each particular case may require. If fluid reaccumulates within three or four days, a retapping should be postponed as long as possible; if, however, a number of weeks elapse before the peritoneal cavity is refilled, the operation may be correspondingly deferred to that time.

Permanent drainage by means of a rubber tube under proper antiseptic precautions has been highly commended by Dr. A. Caillé, whenever, after one or two tappings, the ascitic fluid rapidly reaccumulates. When all other measures of treatment are futile, this method of permanent drainage should be utilized.

While the operation of paracentesis is very trifling, every antiseptic precaution should be employed. In order to produce local anæsthesia a hypodermatic injection of three to five minims of a 2 to 4 per cent. solution of cocaine may be made at the proposed point of operation, or the same result may be obtained by the rhigolene spray or the application of ice and salt. The linea alba, below the umbilicus, is the usual point of election except for loculated effusions. In the latter case, as distended veins ramify extensively over the abdominal wall, caution must be used not to wound any of them with the trocar. As the fluid escapes pressure is kept up by means of a many-tailed bandage: this lessens the risk of syncope and secures a thorough evacuation of the fluid. If the puncture has been made at the side of the abdomen, the patient must lie on the opposite side for some little time, so that the wound may cicatrize properly. This will obviate the occurrence of a fistula, a sequel which will prove a source of great annoyance to the patient, inasmuch as leakage soils the clothing and provokes cutaneous inflammation.

CONGENITAL INTESTINAL MALFORMATIONS

AND

DISEASES OF THE ANUS AND RECTUM.

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I. Congenital Malformations of the Intestines.

Congenital malformations of the small intestine are met with much less frequently than those of the rectum and anus; in the Vienna Foundling Hospital only 9 anomalies of this nature were found among 150,000 infants. The malformation may consist of a stenosis or atresia of the gut; or the bowel may terminate in a cul-de-sac at the point of obstruction, and beyond this point again begin in a cul-de-sac, the remaining portion of the intestine being well developed; or the bowel may have a diverticulum given off which attaches it to the abdominal walls, and this may contain a fistula opening upon some portion of the body; or, finally, the defect may consist in an abnormal shortness of the intestinal canal. Holmes mentions two cases of congenital occlusion of the small intestine in which the diagnosis was satisfactorily established, and Dr. W. Craig reports a case of congenital malformation of the small intestine in a child who lived seventy-two hours, and in whom the autopsy showed an obstruction of the small intestine at the upper fifth of the ileum. The intestine in this case was distended above the point of obstruction, and upon opening the bowel it was found that it ended in a cul-de-sac; further examination of the gut beyond the point of obstruction showed that the intestine began in a cul-de-sac, and the intervening space between these two pouches was occupied by a band of fibrous tissue. The most frequent position of congenital occlusion of the small intestine is the duodenum near the point at which the biliary duct and pancreatic duct open, or at the point where the duodenum becomes jejunum under the transverse mesocolon. Malformations of the ileum are most common near the ileo-cæcal valve, or a short distance above it, where the ductus omphalo-mesentericus is given off. Among the congenital malformations of the small intestine may be mentioned that condition known as Meckel's diverticulum, which consists in a cylindrical or flask-shaped appendage attached to the ileum a metre or more above the ileo-cæcal valve, and is a remnant of the omphalo-mesenteric duct. Another form of this defect consists in the presence at the umbilicus of a reddish tumor covered with mucous membrane, which has been described as a *warty tumor of the umbilicus*, *congenital mucous polypus of the umbilicus*, and as *adenoma of the umbilicus*.

Congenital malformations of the large intestine are also of infrequent occurrence, but may involve the colon, the sigmoid flexure, or the rectum. The malformations of the large intestine may consist of an occlusion of the

gut at any portion of its length; or the gut may exist in a rudimentary condition. The latter defect is most apt to be associated with Meckel's diverticulum, with a fæcal fistula between the ileum and the fissure above the umbilicus, or with a fæcal fistula between the small intestine and some portion of the abdominal walls. Atkin reports the case of a child who died two days after birth, and in whom, upon autopsy, the rectum and colon were found to be in a rudimentary state, smaller than an ordinary quill; in this case the parts had remained in the condition in which they exist in the early embryo.

The various congenital malformations of the small and large intestine are probably largely to be attributed to accidents in development due to a complicated disposition of the intestinal tract of the embryo; and it is also likely that fœtal peritonitis plays an important part in the production of these deformities. Theremin is of the opinion that many of these anomalies are due to changes in the peritoneum which have taken place early in fœtal life.

Symptoms.—The symptoms arising from congenital malformations of the large or small intestine are simply those of intestinal obstruction in a more or less marked degree, which depends upon the completeness of the occlusion; and all observers are agreed as to the absence of any definite symptoms accurately localizing the seat of the lesion. The vomiting of whitish mucus, with obstruction of the bowels, in the case of a new-born infant, points to an occlusion high up in the small intestine, and if the obstruction exists in the jejunum or ileum, this may be replaced by the vomiting of meconium. In such a case the symptoms would in no wise differ from those consequent upon the presence of an occlusion situated in the region of the rectum or anus. If a fæcal fistula is present, the symptoms of obstruction will not be so marked, and the position of the fistula may serve as a guide to the situation of an intestinal malformation.

Diagnosis.—As before stated, the localization of the lesion is often most difficult. In a newly-born child who presents swelling of the belly with vomiting and obstruction of the bowels, the anus and rectum should first be examined to exclude the possibility of malformation of these parts; a soft catheter should be passed into the rectum, and if, upon injecting water, meconium is brought away, it can be inferred that the obstruction exists at a higher point of the intestinal canal.

Prognosis.—The prognosis is always unfavorable: complete occlusions of the duodenum or of the high portion of the jejunum must necessarily prove fatal in a short time; but when the obstruction is incomplete or occupies a position low down in the small intestine, or if associated with a fæcal fistula, the patient may survive for some time, even for years. Complete occlusions are usually fatal within a few days unless relieved by operative treatment.

Treatment.—In cases of complete obstruction operative treatment must be resorted to promptly. Up to the present time the results obtained have not been encouraging; but with the improved technique of abdominal operations more favorable results may be looked for in these cases. As before stated, the diagnosis of the seat of the lesion is often impossible; but as in cases of complete occlusion the result is necessarily speedily fatal, it seems wise to attempt an exploratory operation with the hope of affording relief or bringing about a cure. A median laparotomy, unless there is some definite symptom present which points to the exact seat of the obstruction, should be the operation selected. If upon opening the abdomen the occlusion is found situated in the duodenum or high up in the jejunum, the case must be abandoned as hopeless, unless it be found possible to excise the occluded portion of the bowel and bring the ends together by sutures (circular enterorraphy), or to make

an attempt to establish the continuity by the procedure known as lateral intestinal anastomosis. If the occlusion is due to a membranous septum, this may be exposed by incising the gut, and after it has been perforated or cut away the intestinal wound should be united by Lembert's sutures and the abdominal incision closed in the usual manner. If the occlusion exists low down in the small intestine or in the large intestine, circular enterorraphy or lateral anastomosis may be employed, or an artificial anus may be made by bringing the gut to the abdominal wound, securing it there, and opening it. This latter procedure would seem to be the wiser one, as it requires much less time to accomplish it, and if the patient survives, after he has attained some age an attempt may be made to establish the continuity of the intestinal canal by lateral anastomosis. If a fæcal fistula is present and there are no marked symptoms of intestinal obstruction, no operative treatment should be instituted; but if the patient exhibits symptoms of intestinal obstruction, the fistula should be dilated or incised, and, if relief be obtained, further operative treatment should be postponed until a later period.

II. Congenital Malformations of the Rectum and Anus.

Congenital malformations of the rectum or anus occur, according to various observers, in the proportion of 1 case in 10,000 births.

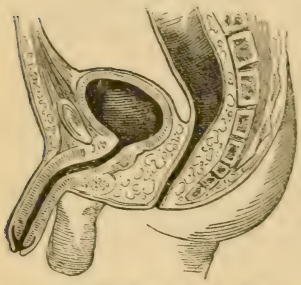
Pathology.—These malformations result from arrested development of the parts in early fœtal life. At its earliest commencement the alimentary canal consists of a simple sac or bag developed from the innermost layer of the blastoderm, partly within and partly without the body; and as development proceeds this communication between the two portions of the sac is shut off, and the portion within the abdomen consists of a simple tube, the *mesenteron*, which terminates at the anterior extremity of the embryo in a blind pouch, while at the posterior extremity a similar pouch is formed. The cul-de-sac at the anterior extremity of the embryo comes in contact and communicates with an invagination of the epiblast, which is called the *stomodæum*, while a similar depression of the epiblast at the posterior extremity of the embryo, named the *proctodæum*, forms the anal orifice and communicates with the mesenteron. The majority of malformations of the rectum and anus are due to an interruption in the latter stages of the process just described, or, in other words, to an arrested or irregular development of the proctodæum or mesenteron. The termination of the rectum in the genito-urinary tract is due, in addition to the arrested development just mentioned, to a similar arrested development in the perineal septum, which separates the rectum from the genito-urinary tract, both, in the early life of the embryo, having a common orifice. The failure of development of the perineal septum explains the frequency of cases of imperforate rectum and anus in which there is a communication between the intestinal tube and the genito-urinary tract.

The best classification of the malformations of the rectum and anus is that adopted by Bodenhamer, and is as follows: 1. Congenital narrowing of the rectum or anus without complete occlusion; 2. Complete occlusion of the anus by a membranous diaphragm or well-formed skin; 3. The anus is absent, and the rectum ends in a blind pouch at a point more or less distant from the perineum; 4. The anus is normal in appearance, but ends in a cul-de-sac, and the rectum ends in a blind pouch at a variable distance above this point; 5. The anus is absent, and the rectum ends by a fistula at any point of the perineum or sacral region; 6. The anus is absent, and the rectum ends in the vagina, the bladder, or the urethra; 7. The anus and rectum are normal, but the

ureter, vagina, or urethra opens into the rectal cavity; 8. The rectum is totally absent.

1. Congenital Narrowing of the Rectum or Anus, without Complete Occlusion.—This variety of malformation is probably more common than is generally supposed, as it escapes notice if the narrowing is not sufficient to produce marked symptoms of obstruction: and probably in many cases of this nature, in which the stenosis is not extreme, the efforts of the child in passing the fæces bring about the necessary amount of dilatation. As the stenosis may not be sufficient to prevent the escape of the semifluid fæces of infant life, the condition may not be detected for some time, and it is only as the child becomes older and the fæces become more consistent that accumulation takes place in the rectum and attention is directed to the malformation (Fig. 1).

Fig. 1.

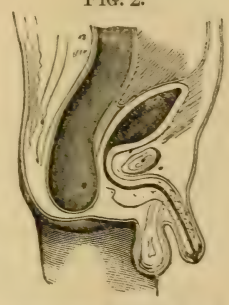


Congenital Narrowing of the Rectum and Anus.

Treatment.—The treatment of this variety of congenital stenosis is best conducted by gradual dilatation, which may be carried out by the daily introduction into the bowel of graduated bougies, or by the introduction of the oiled index finger of the mother or the nurse, which is by far the best of all bougies for this purpose.

2. Complete Occlusion of the Anus by Membranous Diaphragm or by Well-formed Skin.—In this form of malformation closure of the anus may be caused by a diaphragm of mucous membrane or skin, which appears to be due to the adhesion or skinning over of the surface of the anus, the rest of the proctodæum being normally formed (Fig. 2).

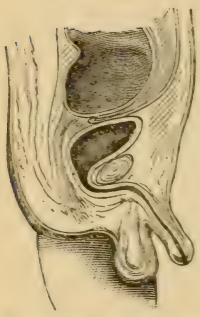
Fig. 2.



Complete Occlusion of the Anus by Membranous Diaphragm or Skin (after Ball).

Treatment.—The treatment consists in making a crucial incision at the position of the anus, opening the rectal pouch, and evacuating the fæces and trimming off the edges of the mucous membrane and skin. The wound should be dusted with iodoform and dressed with a pad of antiseptic gauze, and the subsequent management of the case consists in keeping the anus well dilated for some time to prevent cicatricial contraction.

Fig. 3.



The Anus is absent, and the Rectum ends in a Blind Pouch (after Ball).

3. The Anus is Absent, and the Rectum ends in a blind pouch at a point more or less distant from the Perineum.—In this variety of malformation the rectal pouch may terminate near the skin, or it may end high up in the pelvis and the space between it and the perineum be filled with cellular tissue, or in other cases a distinct fibrous cord can be traced from the termination of the rectum to the skin (Fig. 3).

Treatment.—In the treatment of this malformation—and, in fact, of all forms of imperforate rectum in which complete occlusion exists—the duty of the surgeon is very clear; he should, as soon as possible, attempt to reach the rectal pouch by a perineal incision. The earlier this is attempted the better, for delay in operating certainly conduces largely to a fatal result. I cannot subscribe to the opinion of those who advise delay until the rectum is distended with fæces and gas, which may make

the position of the rectal pouch more apparent, but which is not unattended with the risk of rupture of the intestine and exhaustion of the patient; and it has also been shown that by delay the meconium becomes reduced in bulk through the absorption of the fluids. It should be remembered that the rectum in infants descends in the hollow of the sacrum and is close to the bone, and except at its upper portion is uncovered by peritoneum posteriorly; in front its peritoneal investment descends to a much lower level, and its close relation in this aspect to the genito-urinary tract is an additional reason for the selection of the posterior region for exploratory operation. Various operative measures have been recommended and resorted to in cases of imperforate rectum.

Puncture with a Trocar Canula.—The introduction through the perineum of a trocar and canula was formerly advised, and by its use I have seen the rectum reached and meconium evacuated; but subsequently it is usually found necessary to enlarge the wound made by the instrument to secure free exit of fæcal matter, so that the procedure possesses no advantage over the perineal incision, and has the disadvantage that the rectal pouch may be entirely missed by the trocar and important structures injured by its blind introduction.

Perineal Operation.—This is considered the best operation to undertake in these cases, since, if successful, it leaves the patient with an anus in the normal position, and often with fair control of the bowels, for the anal sphincter is frequently well developed in spite of the malformation of the rectum. In performing this operation the child should be placed in the lithotomy position, and the incision should be made in the median line of the perineum from the root of the scrotum to the coccyx. The tissues should be divided slowly, any bleeding vessels being secured as they are met with. The surgeon should explore the wound with the finger during the operation, to discover, if possible, the bulging of the rectal pouch, and should be careful to make the deepest incisions posteriorly. In a female infant the finger introduced into the vagina during the operation may give the surgeon some information as to the position of the rectum; or if the mass of fibrous tissue in which the rectum sometimes terminates is seen or felt, it may serve as a guide to the position of the rectal pouch. Nearness of the tuberosities of the ischium is a sign of absence of the rectum; and if it is found that the vagina or bladder fills up the concavity of the sacrum, it is an indication of a high termination of the rectal pouch. The incisions may be carried with safety to the depth of an inch and a half or two inches, and when the rectal pouch is reached it should be incised. After the meconium has escaped the wound in the rectum should be sufficiently enlarged, and, if possible, its edges should be brought down and sutured to the skin of the perineal wound, care being taken in passing the sutures and in introducing a drainage-tube to leave no pocket around the bowel for the accumulation of discharges. The suturing of the edges of the bowel to the skin is a most important procedure, and one which diminishes largely the amount of contraction in the newly-formed anus; it may, however, be found impossible to bring down the edges of the rectal wound to the skin in cases where the rectum terminates high up in the pelvis. In such cases a large flexible catheter or a metallic tube may be introduced and held in place by tapes; but it is difficult to keep it in position, as it is apt to be displaced by the straining efforts of the child. Verneuil has suggested excision of the coccyx in the early part of the operation, which facilitates the search for the gut, and in case it is found this procedure enables the surgeon more readily to attach the edges of the rectal pouch to the skin. The dressing of the wound should consist in dusting the parts with iodoform and applying a pad of antiseptic cotton, to be held in position by means of a T bandage.

When the surgeon has carried his dissection up into the pelvis as far as he considers it is safe, an inch and a half or two inches, and has failed to reach the rectal pouch, he should then consider the advisability of abandoning the attempt to reach the gut through the perineum, and should endeavor to open the intestine either in the left groin (Littre's operation), or in the left loin behind the peritoneum (Amussat's operation), or in the right groin (Huguier's operation). Of these operations, that in the left groin is to be recommended, as it opens the bowel near its natural termination. If the surgeon decides upon this operation, he should make an incision from one and a half to two inches in length, half an inch above and parallel with Poupart's ligament, beginning at a point opposite the junction of the middle with the outer third of this structure. Or an incision suggested by Ball, following the line of the linea semilunaris, stopping just short of Poupart's ligament, may be substituted for the former incision. The skin and muscular layers being cut through, the fascia transversalis and peritoneum may be pinched up together, and a small opening made in them, through which a director should be passed, and the two can then be divided with one incision. It is sometimes difficult to determine whether the bowel presenting in the wound is the small or large intestine ; this can be ascertained by gently drawing out a coil : if it be the small intestine, it can be drawn out with ease, and the mesentery will show that it is not the portion of the bowel sought for, and it should be replaced. On the other hand, the large intestine cannot be so readily drawn out, and its mesocolon, if it have one, would be found attached to the left side. The bowel should next be secured to the edges of the wound by several sutures of fine silk or catgut, which should be introduced by passing a curved needle through the skin and parietal peritoneum near the edge of the wound, and then transfixing a portion of the bowel ; after which the needle should be made to transfix the peritoneum and skin again, being brought out a short distance from the point of insertion ; the stitches should then be secured. Sutures should be applied in this manner on each side and at the extremities of the incision, after which the gut should be incised to a sufficient extent and the meconium allowed to escape. After the escape of the latter the wound should be carefully cleansed, and the edges of the gut incision may be attached to the skin by a few silk sutures. The surgeon may introduce the finger or a flexible rubber catheter into the opening in the gut to ascertain, if possible, the point of termination of the rectal pouch ; and if it is found to be near the upper portion of the perineal incision, he may deepen the latter on a guide introduced through the artificial anus. It has, however, been found better to rest satisfied with the relief afforded by colotomy, and to postpone for a time the attempt to form an anus in the perineal region, for the majority of cases in which this has been attempted have been followed by a fatal result. Attempts to accomplish this result some months after the performance of colotomy have been more satisfactory, as is seen in cases reported by Byrd and Krönlein. When the patient has attained some age, and an examination through the artificial anus in the left groin shows that the rectal pouch terminates well down in the pelvis, a director or rubber catheter may be introduced through the colotomy wound and made to enter the pouch, and project at the anus, if it be present, or at some point of the perineum. This may then be cut down upon as a guide, and the gut may be opened and sutured to the skin if the edges can be drawn down to that point.

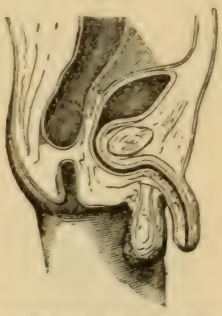
If the surgeon should prefer to make an attempt to open the bowel in the left lumbar region, the best guide to the position of the colon is a line half an inch posterior to a point midway between the two superior spinous processes of the ilium ; if he fails to find the large intestine, and distended small intestine

shows itself in the wound, it is better to open this and stitch it to the wound, rather than to abandon the case and allow the patient to perish by intestinal obstruction.

The results obtained by the various operations for the relief of the symptoms due to imperforate rectum show that, in point of safety and as a matter of comfort to the patient, the perineal operation is to be preferred. Cripps has collected 100 cases of the various operations for the relief of imperforate rectum; his table, although exhibiting a high rate of mortality, 50 per cent., shows that the largest number of recoveries followed the perineal operation, and the next in number were those cases in which the colon was opened in the iliac region. The expediency of an operation for the establishment of an artificial anus, either in the perineum or in the groin, in young children with imperforate rectum, is evidenced by a number of well-attested cases in which the patient lived for years afterward in comfort.

4. The Anus is Normal in Appearance, but Ends in a Cul-de-sac, and the Rectum Ends in a Blind Pouch at a very little Distance above this Point.—In this form the anus and rectum may be separated by a membranous partition of greater or less thickness, or a portion of the bowel may be impervious, or there may be multiple obstructions, or the anal portion may communicate with the vagina in the female and the rectum end in a cul-de-sac (Fig. 4). The variety of malformation in which the anus is normal, but is separated from the rectum by a membranous partition of greater or less thickness, is not uncommon. It is apt to escape notice for some time, as the anus is normal in appearance, and it is only when the nurse or mother notices that the child passes no fæces and the belly becomes swollen, or vomiting begins, that the nature of the trouble is suspected. The introduction of the finger or probe into the anus will soon reveal the nature of the trouble. An attempt should at once be made to reach the rectal pouch by an incision through the anus backward toward the coccyx, and if the gut be found it should be brought down and sutured to the edges of the anal wound. This procedure is much safer than puncture through the anus, which the surgeon might feel tempted to employ if the partition between the two cavities did not seem very thick. If it be found impossible, after a careful dissection in the perineal region, to find the rectal pouch, the surgeon should abandon this operation, and attempt to reach the gut by an incision in the left iliac region.

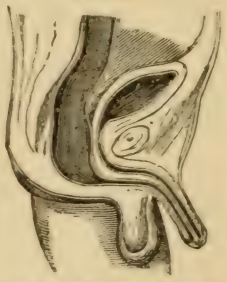
Fig. 4.



Anus ends in a Cul-de-sac, the Rectum ends in a Blind Pouch (after Mollière).

5. The Anus is Absent, and the Rectum Ends by a Fistula at any point of the Perineum or Sacral Region.—The rectum may open at some portion of the perineum or sacral region, or it may terminate in a narrow channel under the raphé of the perineum and open at the prepuce or at the symphysis pubis, or may end in several fistulæ at different points (Fig. 5). Such patients may have satisfactory evacuations through the fistulæ, and may live for months or years without suffering much inconvenience from the deformity.

Fig. 5.



Anus is absent; Rectum ends by a fistula at the prepuce (after Ball).

Treatment.—If a child so suffering shows evidence of discomfort by reason of the fæces not passing sufficiently freely through the fistula, this should first be dilated or increased in size by incision, and if relief

from the symptoms be obtained, no further operation should be attempted as long as the child remains in comfort. When the patient has attained an age when a more radical operation can be undertaken, the fistula may be explored with a probe or director, and the position of the rectal pouch ascertained if possible; if it be in a favorable position, a perineal opening should be made to reach the rectum, and when it has been found the bowel should be opened and its edges brought down and sutured to the edges of the perineal wound. The fistulous tract should be laid open or touched with the actual cautery, and allowed to heal by granulation.

6. The Anus is Absent, and the Rectum Ends in the Vagina, Bladder, or Urethra.—These malformations, according to the point of termination of the rectum, are classified as *atresia ani vaginalis*, *atresia ani vesicalis*, and *atresia ani urethralis*. Leichtenstern's statistics show that 40 per cent. of rectal malformations are of this nature. This tendency of the rectum to terminate in the genito-urinary tract is remarkable when we consider the definite separation which exists between the rectum and the genito-urinary tract in the adult: it is attributed by Ball to the method of development of the proctodæum, or a tendency to reversion to the cloacal type of birds and lower animals.

Atresia Ani Vaginalis.—In this form the rectum terminates in the posterior walls of the vagina, either by a small or large aperture. The opening may be situated immediately within the fourchette, or may be located high up in the canal (Fig. 6). If the rectal opening is sufficiently large, the patient does not exhibit any symptoms of intestinal obstruction, and the nature of the deformity is only ascertained upon inspection of the parts, when it is found that the anus is absent, and that fæcal matter escapes from the vulva.

Fig. 6.



Anus is absent; Rectum ends in the vagina. (After Ball.)

Treatment.—If the patient suffers no inconvenience, operative treatment may be postponed until she has attained some age, when the greater development of the parts will conduce to a favorable result. Operations for the relief of this variety are the most satisfactory in their results of all those that have been devised for the cure of congenital malformations of the rectum. When an operation is decided upon, the one which is followed by the best results is performed in the following manner: A director is passed through the vaginal opening into the rectum and is pushed backward, its point being made to project as near as possible to the normal position of the anus; this is cut down upon from the perineum and the rectum is exposed and incised. The rectal wound being then sufficiently enlarged, the gut is dissected loose and its edges are brought down and secured to the skin by sutures. By this dissection of the rectum and bringing down of its edges, the opening into the vagina, if it be a low one, is obliterated. If a high opening into the vagina remain after the anus has been established in its normal position, an operation may be undertaken later to close this recto-vaginal fistula. An ingenious operation, devised by Rizzoli, for the relief of this malformation is performed as follows: An incision is carried from the lower margin of the vaginal anus backward through the perineum toward the coccyx, care being taken not to open the intestine; the termination of the rectum with its vaginal orifice is now carefully dissected out, and the abnormal anus is transplanted to its natural situation and secured in that position by a few sutures, after which the perineal and vaginal wounds are brought together by deep sutures.

Atresia Ani Vesicalis.—In this variety the rectum communicates with the

bladder, either by a narrow orifice near the base of the organ or by an opening near its fundus (Fig. 7). The absence of the anus and the escape of fæcal matter intimately mixed with urine at the time of urination would point to the nature of this very serious malformation.

Fig. 7.



Anus absent; the Rectum ends in the Bladder. (After Ball.)

Treatment.—In the treatment a staff may be introduced through the urethra into the bladder, and an incision made through the perineum into the neck of the bladder, as in lithotomy, and continued into the rectum. As the result of this operation the immediate symptoms of obstruction may be relieved, but the patient is left with a urinary and fæcal fistula. Ball suggests a laparo-colotomy, and, when the colon has been found, its complete division, with closure of the lower portion and the bringing out of the upper portion at the wound, and securing it in that position to establish an artificial anus. This operation, although attended with greater immediate risk, has the advantage of leaving the patient with control over his urinary excretion.

Atresia Ani Urethralis.—In this form the rectum communicates with some portion of the urethra, allowing the escape of a small amount of fæcal matter, which passes more or less in the intervals between urination. The urethral opening is usually so small that fæces cannot escape in sufficient quantity, and the symptoms of intestinal obstruction are soon developed (Fig. 8).

Fig. 8.



The Anus is absent; the Rectum ends in the Urethra. (After Ball.)

Treatment.—The treatment consists in attempting to find the rectum by means of perineal incision, opening it, and bringing down the edges of the gut and suturing them to the skin.

7. The Anus and Rectum are Normal, but the Ureters, Vagina, and Uterus Open into the Rectal Cavity.—As this is a malformation in which occlusion of the bowel does not exist and life is not endangered by its presence, no immediate operation is called for. Where the ureters open into the rectum, no operative interference could be of any avail, but in that form in which the vagina or uterus opens into the rectum, and the child has attained some age, an operation to close the fistula and replace the organs may be attempted.

8. The Rectum is totally Absent.—This differs from the third variety of malformation only in the amount of rectum which is wanting, and its existence may be suspected in those cases in which an exploration of the pelvis by perineal incision fails to reveal the presence of the rectal pouch. This condition is to be treated by laparo-colotomy, in the left inguinal region, and the formation of an artificial anus.

9. The Large Intestine is totally Absent.—This condition is often associated with a fæcal fistula at the umbilicus or some other portion of the body, and its treatment consists in securing a free exit of fæces from this fistula by dilatation or careful incision, or by the formation of an artificial anus if no fistula be present.

III. Diseases of the Anus.

Pruritus Ani.

This affection is occasionally seen in childhood, and is characterized by a painful itching in the region of the anus, which causes the child constantly to scratch the part, so that the skin in the vicinity becomes thickened, eczematous, and moist from exudation as a result of the constant irritation. Pruritus ani may result from various causes—from the presence of oxyuris vermicularis in the rectum, from eczema of the anus, from pediculi or scabies, or from the presence of a vegetable parasite, as is the case in eczema marginatum. In other cases in which the itching is not attributable to any of the above-named causes it can often be traced to improper diet or chronic constipation.

Treatment.—Where the condition can be traced to the presence of eczema, the parts should be frequently bathed with hot water and washed carefully with green soap, and one of the following lotions may be used:

℞. Acidi carbolici . . . . . ℳxx.
Liquor. calcis . . . . . f℥vj.—M.

Or,

℞. Acidi carbolici . . . . . f℥ss.
Glycerini . . . . . f℥j.
Aquæ . . . . . q. s. ad f℥vj.—M.

Or the following ointment may be applied:

℞. Ung. picis liquidæ . . . . . ℥j.
Ung. zinci oxidi . . . . . ℥iij.
Ung. aquæ rosæ . . . . . ℥iv.—M.

When the itching can be traced to the presence of parasites, either animal or vegetable, the use of some of the antiparasitic lotions or ointments appropriate for the individual case will rapidly effect a cure. Where the condition is dependent upon errors in diet, a change of diet will often be followed by satisfactory results. Where the trouble arises from chronic constipation, a change of diet should be made and laxatives should be administered, or enemata or suppositories of glycerin should be employed.

Syphilitic Affections of the Anus.

Mucous patches and moist papules occur with comparative frequency in the region of the anus as the result of congenital syphilis. Allingham speaks of numerous cracks or fissures of the mucous membrane of the anus in children suffering from hereditary syphilis. Condylomata may appear upon these syphilitic lesions: they are acuminated and spring from previously existing papules or mucous patches, and are accompanied by discharges of a characteristic fetid odor. These growths are to be distinguished from the simple forms of vegetation which frequently occur in this region, and are not dependent upon the presence of inherited syphilis.

Treatment.—The treatment should be both constitutional and local. The constitutional effects of mercury can best be obtained in young children by the use of a binder spread with mercurial ointment applied around the abdomen. The local treatment of the anal lesions consists in the application of the

solid stick of nitrate of silver, or, better, the acid nitrate of mercury, or in dusting them with a powder consisting of equal parts of calomel and oxide of zinc.

Vegetations or Warts of the Anus.

Vegetations of the anus are not infrequent in childhood, and the growths may attain great size. They are similar in structure to warts situated in other parts of the body, and are papillary overgrowths covered with squamous epithelium. From their situation they are apt to be kept in a moist condition, and as a result there is often present a certain amount of offensive discharge.

Treatment.—If the parts can be kept perfectly dry, a cure will usually rapidly result: with this end in view, when the growths are not large, dusting with lycopodium or powdered oxide of zinc will often be followed by their disappearance. If the growths are large, they may be touched with the solid stick of nitrate of silver or a saturated solution of chromic acid; or they may be destroyed by the application of the actual cautery, or trimmed away with scissors. The objection to the latter mode of removing them is the profuse hæmorrhage which may result, but this can generally be controlled by the application of a firm compress to the bleeding surface.

Fistula in Ano.

Fistula in ano is an affection in which there is a communication between the mucous surface of the rectum or anus and the skin in its immediate neighborhood. A complete rectal fistula is one in which there is a sinus leading from the rectum to some point of the skin in the region of the anus; an incomplete fistula or an internal rectal sinus is one in which there is a sinus passing from the rectum into the perirectal cellular tissue; another form of incomplete fistula is known as the external rectal sinus, and is one in which there is an opening on the skin passing into the cellular tissue around the rectum, but not perforating the wall of the gut. Fistula in ano is certainly a rare affection in infants and children. Allingham mentions the fact of its occurrence in children of a very tender age. I have myself seen a few cases in children, and recall a case of complete fistula in a child a few months of age. The affection may result from perforating ulceration of the mucous membrane of the rectum, or from an ischio-rectal abscess opening into the rectum or through the skin in the vicinity of the anus, and also from wounds involving the rectum or anus.

Diagnosis.—This affection is usually not difficult to diagnose if the finger be introduced into the rectum and a probe passed into the external opening, when, by a little careful manipulation, the probe may be made to enter the bowel if the fistula be a complete one. In the incomplete form of fistula known as internal rectal sinus, careful palpation of the tissues surrounding the anus will often reveal an indurated mass of tissue which indicates the position of the internal fistula, and the finger introduced into the rectum may also feel the orifice of the internal opening; while the discharge of pus with the stool points to the existence of this affection. In the form of incomplete fistula known as external rectal sinus, if the finger be introduced into the rectum and a probe passed into the external opening, it can be felt at some point to come near the wall of the bowel. In children it should be remembered that, in certain cases of disease of the bones of the spine, of the sacrum, or of the pelvis, the purulent matter passing through the connective tissue about the rectum may find its way to the surface and perforate the skin in the neighborhood of the anus; or it may open into the rectum and escape by the

anus. A careful examination of the patient, however, will reveal the origin of the pus and show that it is not a case of ordinary fistula in ano.

Treatment.—The treatment of this affection consists in the free division of all the tissues between the internal and external opening of the fistula, and is accomplished as follows: A director having been passed into the external opening of the fistula, the finger is introduced into the rectum, and when the point of the director is felt it is passed through the internal opening and brought out at the anus; the superimposed tissues are then divided with a bistoury. The track of the fistula should next be carefully explored to discover the presence of any branching sinuses running off from it, and if these be found they should be freely laid open. The wound resulting should next be touched with the solid stick of nitrate of silver, or curetted, irrigated with a solution of bichloride of mercury, and packed with strips of iodoform gauze; this dressing should be changed at intervals of a few days, and the wound is to be allowed to heal by granulation. In cases of incomplete external fistula the director should be introduced into the external opening, and where its point comes in contact with the gut, guided by the finger in the rectum, it should be made to perforate, and its point brought out at the anus. The superimposed tissues are then divided, as in the operation for complete fistula. In the variety of incomplete fistula known as internal rectal sinus, the position of the fistula being located as before described, an incision should be made through the skin at this point, and a director introduced and made to enter the rectum, its end being brought out of the anus. The subsequent treatment of the case differs in no wise from that of the complete fistula. Another method of treatment in incomplete fistula of either variety is to lay the sinus freely open down to the bowel without dividing the sphincter, and to pack the wound with iodoform gauze: in this way a cure may often be brought about. In any case of fistula in which the internal communication is very high up in the rectum, and its division by the knife is considered unsafe by reason of the hæmorrhage which may result, an elastic ligature may be introduced through the external opening by means of an eyed probe and brought out at the anus, after which the ligature is tied and allowed to cut its way out, and the wound resulting is treated like that following division of the tissues by the knife.

Fissure of the Anus.

Fissure of the anus is an affection in which there exists at some portion of the mucous membrane of the anus a small linear ulcer, which causes great pain at stool or after the bowels have been moved. This affection is considered infrequent in childhood, but I am of the opinion that its presence is not so unusual as is generally supposed, and feel sure that a careful inspection of the anal region in children who complain of pain at or after stool will often show its presence. Allingham and Curling mention cases which they have met with in quite young patients, and I have myself seen cases of this affection in children. Kjellberg of Stockholm among 9098 children found 128 cases of fissure of the anus. The majority of these children were less than one year of age, and in 73 cases the patients were less than four months old. Jacobi thinks fissure of the anus a much more common affection in children than is generally supposed, and believes that many of the fretful children who sleep badly and cry constantly, and often present symptoms similar to those of vesical calculus, suffer from fissure of the anus.

Diagnosis.—Fissure of the anus should be suspected in cases where pain is experienced during or after stool and where the stool contains a few drops of

blood. In such cases a careful inspection of the part will usually reveal the presence of a fissure. The rectum should at the same time be examined with the finger for the presence of polypus, which frequently coexists with fissure of the anus.

Treatment.—The treatment of this affection in children can generally be successfully accomplished by an application of a 20-grain solution of nitrate of silver to the ulcer, or by lightly touching the surface with the solid stick of nitrate of silver, and afterward keeping the parts well covered with an ointment composed of thirty grains of iodoform or aristol to the ounce of vaseline, the bowels being kept in a soluble condition. In cases which are found intractable division or stretching of the sphincter may be resorted to.

Stricture of the Anus.

This affection may be congenital or may result from an operation in the vicinity of the anus. The treatment of stricture of the anus consists largely in gradual dilatation of the contracted orifice, either instrumental or digital; if this fails to relieve the condition, a careful incision of the contracted parts should be practised, and subsequent dilatation should be employed for some time.

Marginal Abscess.

This affection consists in circumscribed suppuration starting in the mucous follicles of the anus, or from a fissure of the anal margin, and is a much more common and less serious affection in childhood than ischio-rectal abscess. Although painful, it is not apt to result in the formation of a fistula in ano.

The treatment consists in making a free opening with a bistoury, and to accomplish this the tip of the finger should be passed into the rectum to steady the abscess-cavity and make it more prominent before it is incised; the wound should then be dressed with iodoform gauze or with lint saturated with carbolized oil, and usually heals promptly.

Diphtheria of the Anus.

This affection is occasionally seen in children suffering from diphtheria of the pharynx, and usually develops late in the disease and in cases in which the system has been profoundly impressed. The deposit of diphtheritic membrane may involve the anus and extend on to the buttocks, and to the mucous membrane of the vulva in female children.

The prognosis is extremely unfavorable, and the cases which have come under my personal observation have all terminated fatally in spite of treatment.

The treatment consists in the employment of such constitutional remedies as are appropriate for diphtheria, and the local application to the affected surface of a solution of bichloride of mercury, 1 : 2000 or 1 : 4000, followed by the use of an ointment of iodoform.

IV. Diseases of the Rectum.

Proctitis.

Inflammation of the rectum, or proctitis, is an affection frequently seen in childhood. It may result from injury to the mucous membrane by the fæces or by materials contained in the fæces, or it may follow from traumatism received

from without. It is recognized in two forms—acute catarrhal and chronic catarrhal proctitis.

Acute Catarrhal Proctitis.—In this affection the inflammatory symptoms are limited to the rectum, and the disease is characterized by great tenesmus and the frequent passing of bloody mucus, at first mixed with fæces. In addition to these symptoms there are usually present œdema of the mucous membrane of the anus and of the lower portion of the rectum, and vesical irritation; and as a result of this condition and the constant straining there is often observed a partial prolapsus of the rectum. Many of the symptoms presented are those of acute dysentery, but the abdominal pain and the constitutional features of the latter affection are generally wanting.

Treatment.—The patient should be kept in a recumbent posture, and small doses of castor oil or one of the saline cathartics, either sulphate of sodium or of magnesium, or one of the natural mineral waters, should be administered to secure free evacuation of the bowels. The diet should be restricted to milk, animal broth, and eggs. If, after the bowels have moved, tenesmus continues, an enema consisting of a few drops of tincture of opium and starch-water should be injected into the rectum; or a rectal suppository containing powdered opium grain $\frac{1}{8}$, extract of belladonna grain $\frac{1}{6}$, iodoform grain 1, should be administered, and if the patient shows signs of exhaustion stimulants should be employed. The disease is usually of short duration, and under treatment the symptoms generally subside in a few days.

Chronic Catarrhal Proctitis.—This disease usually results from the acute affection, and is characterized by the absence of pain and tenesmus, although in some cases in which ulceration of the mucous membrane of the rectum exists there may be discharged a small quantity of blood and muco-purulent matter.

Treatment.—The diet should be regulated as in acute proctitis, and if the evacuations are not sufficiently free the bowels should be moved by the administration of a saline cathartic. The local treatment should consist in the use of enemata of nitrate of silver, $\frac{1}{4}$ to 1 grain to an ounce of water, which should be gradually increased in strength until they begin to cause pain; suppositories of iodoform and extract of belladonna may also be employed with advantage.

Periproctitis.

Periproctitis is an inflammatory condition involving the connective tissue surrounding the rectum. It may result from septic causes or direct injury, or may arise from the introduction of foreign matter through ulceration or perforation of the rectum. Abscess or gangrene of the cellular tissue may result, with subsequent involvement of the skin; erysipelas also may attack this region, giving rise to erysipelatous periproctitis.

Treatment.—In this affection, as soon as the swelling and induration can be detected, free incision should be made through the skin and into the cellular tissue outside of the margin of the anus, and the wounds thus produced irrigated with a solution of bichloride of mercury, 1 : 1000 or 1 : 4000, or touched with a solution of chloride of zinc, 15 grains to the ounce. The surfaces then should be dusted with iodoform, and covered with a bichloride-gauze and cotton dressing. If the parts are found to be gangrenous, a charcoal or an antiseptic poultice should be applied, and the patient should be given alcohol and tonics with a liberal diet.

Ischio-rectal Abscess.

Ischio-rectal abscess consists of a purulent collection in the loose cellular tissue surrounding the rectum. It is a most painful and serious affection, and

is the most frequent cause of fistula in ano. It may arise from injuries of the rectum, either from within or from without, from phlebitis or periphlebitis of the hæmorrhoidal veins, or from the escape of fæcal matter into the cellular tissue through ulcers perforating the rectum. The most characteristic symptom of ischio-rectal abscess is a sense of fulness in the lower portion of the rectum, with throbbing pain, which is increased at the time of stool. Where this affection is suspected a careful examination of the rectum with the finger will often disclose a bulging of the rectal wall at some point, and this is often accompanied by swelling and œdema of the skin near the anus; the presence of fluctuation in this region will often be revealed upon palpation.

Treatment.—This form of abscess demands prompt and free opening, and by this treatment alone is the pain relieved and the risk of the formation of a fistula in ano avoided. In opening these abscesses I usually follow the practice of Allingham, who recommends that the patient should be etherized and placed in the lithotomy position. An incision should be made at a little distance from the anus parallel with the sphincter, the abscess-cavity laid freely open, and the finger introduced into the wound to break down any secondary cavities or loculi. If it is found that there has been much undermining of the tissues, incisions should be made at right angles to lay all cavities freely open. The abscess-cavity should then be irrigated with a solution of bichloride of mercury, 1 : 2000 or 1 : 4000, or with a 1 : 40 solution of carbolic acid; and the wound should next be carefully packed with lint saturated with carbolized oil, 1 : 30, or, as I prefer, with iodoform gauze. An external dressing of iodoform or bichloride gauze and a pad of bichloride cotton is then applied to the wound and held in position by a T bandage. This dressing need not be disturbed, unless it become loose or soiled, for several days, when the cavity should be irrigated and a few strips of gauze laid lightly in it. The wound should be allowed to heal by granulation. If the bowels do not move in one or two days, a gentle laxative may be administered. By this method of treatment the cavity of the abscess rapidly heals, and a cure results without the formation of a fistula in ano.

Ulceration of the Rectum.

Ulceration of the rectum is not a common affection in childhood, but it sometimes results from chronic dysentery or chronic catarrhal proctitis.

The treatment consists in the local use of injections of nitrate of silver, grain ¼ to 1 to the ounce of water, and in the use of suppositories of iodoform. A restricted diet should also be enjoined, and the bowels should be regulated.

Stricture of the Rectum.

This affection may result from the presence of new growths, from the contraction following wounds of this organ, the result either of accident or operation, and also from congenital malformations of the rectum; inherited syphilis is mentioned as occasionally causing congenital stricture of the rectum.

The treatment consists in gradual dilatation of the rectum, either instrumental or digital; if the condition be due to the presence of growths, their removal should be accomplished if possible; and if due to inherited syphilis, antisyphilitic treatment is indicated, in addition to the local measures.

Syphilis of the Rectum.

Lesions of the rectum, due to inherited syphilis, are occasionally seen in childhood. A case of gummatous infiltration of the coats of the rectum in a child ten years of age, at the same time exhibiting well-marked symptoms of

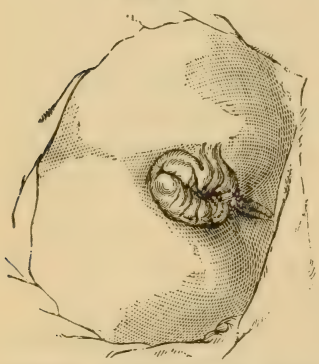
inherited syphilis, has been described by Ball; and Oser of Cracow has reported two cases of gummatous infiltration of the intestines in children suffering from congenital syphilis.

The treatment of syphilitic lesions of the rectum consists in the administration of mercury or iodide of potassium, as in the treatment of corresponding syphilitic lesions in other parts of the body.

Prolapsus of the Rectum.

Prolapsus of the rectum consists in the protrusion of a portion of the rectum through the anus, and occurs in three varieties: 1. A portion of mucous membrane protrudes from the anus (partial prolapsus); 2. The entire thickness of the walls of the rectum is included in the prolapse (complete prolapsus); 3. There exists an invagination as well as a prolapsus of the rectum. This affection in some one of its varieties is very common in childhood, and the frequency of its occurrence may be accounted for on both anatomical and pathological grounds. The looseness of the attachment of the submucous connective tissues of the walls of the rectum is a well-recognized anatomical fact; and this condition is an important factor in the production of prolapsus. The straightness of the coccyx in children is also said to favor its production. In infants and young children the great amount of straining that seems to be required to bring about satisfactory evacuations is also productive of this affection; this straining has been ascribed by Jacobi to the anatomical fact that in children it is not uncommon to find two or three angular flexures in the lower part of the colon. The habit so common with mothers and nurses of placing children upon the chamber utensil and allowing them to spend a large portion of time in that position is certainly, to my mind, a frequent cause of the development of prolapsus, and is a custom which cannot be too severely condemned. In many cases the constant straining due to the presence of vesical calculus or rectal polypus, or to a contracted prepuce, may be an important factor in the production of this affection. Improper diet, or the custom of allowing children to eat at all hours during the day —and as a result of this over-feeding the production of a large number of passages—may also be mentioned as a cause. That improper diet and over-feeding produce prolapsus of the rectum is, in my mind, very clearly proved by the fact that at the Children's Hospital of Philadelphia we often have children admitted to the wards for operation who have suffered from this affection for months: under the use of tonics, proper diet, and regulation of the bowels they fail to further present prolapsus, and are thus soon relieved of the condition without operative interference. Mr. Holmes of London makes a similar observation as to his experience in this affection.

Fig. 9.



Prolapsus of the Rectum. (After Bryant.)

Symptoms.—The characteristic symptom is the protrusion, during defecation, of a reddish-purple mass covered with mucous membrane: it is unaccompanied by pain, and usually undergoes spontaneous reduction as soon as the straining efforts cease. In the partial variety of prolapsus of the rectum little inconvenience is experienced, unless the prolapsed portion of the bowel is allowed to remain out for some time, when it may become congested or ulcerated; the latter condition is more likely to occur in cases of complete pro-

lapsus. When the prolapsus is of the third variety and is accompanied by invagination of the rectum, the symptoms of obstruction of the bowel exist, and gangrene of the protruded mass may occur. Death has resulted in such cases from obstruction as well as from peritonitis.

Diagnosis.—Prolapsus of the rectum is likely to be confounded only with hæmorrhoids, which is an extremely rare affection in childhood, or with polypus of the rectum. The appearance of the prolapse is very characteristic: the annular fold of tissue surrounding the whole anus with its depressed central orifice, and the fact that after reduction of the mass no tumor can be found in the rectum, would exclude the presence of polypus. The cases most likely to give rise to error are those of intussusception in children where the intussusceptum protrudes from the rectum, and resembles in appearance a prolapsus. Such cases have been found with prolapsus of the rectum; but if the surgeon makes a careful examination of the protruded mass, and takes into consideration the previous history of the case, such as sudden pain and collapse or the occurrence of more or less obstruction of the bowels, with the passing of blood and mucus preceding the appearance of the tumor through the anus, he will not be likely to confound the two affections.

Treatment.—The palliative treatment of this condition consists in returning the mass through the anus as soon as possible. This is best accomplished by placing the patient across the knees and making gentle pressure with the fingers over the whole mass of the tumor for a few moments, to return the contents of the bowels and the fluids effused in the tunics, and then pushing up the central portion first with the finger. Little difficulty is experienced in effecting this reduction in recent cases, but where the prolapsus has been down for some time and inflammatory effusion has taken place, it may be necessary to administer an anæsthetic before the reduction can be satisfactorily accomplished. The preventive treatment consists in not allowing the child to make prolonged straining efforts on the chamber-utensil or to have the bowels moved in a sitting posture. A child who is subject to prolapsus of the rectum should have the bowels moved while in the recumbent position on the bed-pan, or on the side, or in a standing posture; and the nurse should support the perineum and anus by two fingers placed one on each side of the anus, or by forcibly drawing the skin of the buttock to one side while the child is passing the stool. When the affection depends upon the presence of a vesical calculus, a contracted prepuce, or a rectal polypus or parasites, producing great straining efforts, the removal of the cause will usually effect a cure promptly. The importance of carefully regulating the diet has been previously mentioned, and care in this respect alone may bring about a cure. Enemata of astringent solutions, such as decoction of oak bark, a solution of alum, or cold water, or suppositories containing extract of nux vomica and ergot, have been employed; and of these the enemata of decoction of oak bark, or of cold water, are most satisfactory. In cases where these various palliative measures have failed to relieve the condition, I think the safest and, in my experience, the surest method of treatment is that recommended by Allingham. This consists in the application of nitric acid to the mucous membrane of the protruded gut. The child's bowels having been previously opened by the administration of a small dose of castor oil or by the use of an enema, he is etherized, and the surface of the prolapsed bowel is carefully cleansed and dried of mucus by wiping it with absorbent cotton; the whole surface of the mucous membrane is next painted with nitric acid applied with a swab, care being taken not to allow the acid to come in contact with the adjacent skin. A pledget of oiled cotton or lint is next introduced into the central depression

of the prolapsed mass, and by pressing it upward with the finger the mass is reduced. Finally, a pad is placed over the anus and held in position by bringing the buttocks together over it by means of broad strips of adhesive plaster. The bowels should be kept quiet for two or three days by the administration of a small amount of opium; and at the end of that time they should be opened by a laxative. The introduction of the oiled cotton or lint I have found in practice unnecessary, as it is apt to be passed by straining when the patient recovers from the anæsthetic; hence I generally omit its use, and merely coat the cauterized surface of the bowel with olive oil or vaseline before reducing it. The recurrence of the prolapsus may take place with the first few passages, but a permanent cure generally results from one application of the nitric acid. Should this, however, not be the case, cauterization may be repeated in a few weeks. The ligature and the clamp and cautery or actual cautery have been employed in the treatment of this affection, but as their use is attended with danger in cases of complete prolapsus of the rectum, and as I have never seen a case in a child in which the simpler and safer procedure, cauterization by nitric acid, has failed to give satisfactory results, I do not think their employment is to be recommended. In cases of prolapsus of the rectum in which invagination has occurred and the patient is suffering from obstruction of the bowels, if the mass cannot be returned under ether an artificial anus should be made in the left inguinal region; and if the child survives after the invaginated portion of the gut has been removed by sloughing or other means, an attempt may be made to close the fæcal fistula in the inguinal region, and thus allow the fæces to escape through their natural channel.

Hæmorrhoids.

Hæmorrhoids are vascular tumors which occupy the lower portion of the rectum, and arise from dilatation or proliferation of the blood-vessels. They may be either internal or external, and are covered either by mucous membrane or skin. Hæmorrhoids are uncommon in childhood, but are occasionally seen, and may consist either of dilated veins or well-marked venous tumors. Allingham records a case of well-marked hæmorrhoids which he saw in a child three years of age. I have myself seen several cases in quite young children, and have seen recently with Dr. Starr a child three years of age who suffered from well-marked venous hæmorrhoids, which protruded and bled at stool, and presented symptoms severe enough to call for operative interference. Ball also has observed several cases in young children. The symptoms presented by hæmorrhoids in children are similar to those in adults, and consist in protrusion of the tumors and bleeding at the time of defecation.

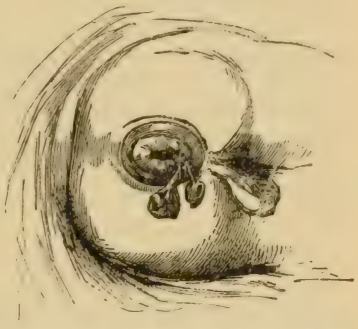
Treatment.—As hæmorrhoids are apt to occur in strumous children, the administration of iron and cod-liver oil is often followed by decided benefit, and locally the use of astringent ointments and the regulation of the action of the bowels may be followed by marked amelioration in the condition. If, however, the tumors continue to bleed and to be protruded at stool, operative treatment is indicated, and the masses may be removed either by the use of the ligature or, as I prefer, by the clamp and cautery.

Polypus of the Rectum.

Polypus of the rectum is a much more common disease in childhood than hæmorrhoids, and is characterized by the presence of a follicular tumor springing from the mucous membrane of the rectum at a point an inch or an inch and a half above the anus; it is attached by a pedicle. The form of

polypus most commonly seen in childhood is of the follicular or adenoid variety, and resembles in structure the normal mucous membrane of the rectum, from which it originates; but fibrous and cystic polypi have also been observed. Mr. Thomas Smith has recorded three cases of disseminated polypi of the adenoid variety occurring in young persons, and Cripps also reports cases of multiple polypi springing from the surface of the rectum and colon.

Fig. 10.



Polypi of Rectum with Prolapsus. (After Ball.)

A rectal polypus is of a bright-red color when first extruded, but becomes darker and more venous in appearance after it has been protruded for some time and its circulation has been interfered with by constriction of the sphincter. The growths may be either single or multiple, and have pedicles varying from ½ to 2 or 3 inches in length. Polypus of the rectum is comparatively rare in children: Bokai found 25 cases of this growth in 65,970 patients, and Jacobi says that he sees from 1 to 3 cases annually among 500 children. A rectal polypus is apt to produce expulsive efforts with tenesmus, and give rise to a sense of fulness or distress in the lower part of the rectum, and to be accompanied by the escape of glairy or bloody mucus or of blood.

Diagnosis.—The diagnosis is usually not difficult, as the growth is apt to present at the anus or to protrude from it during defecation, and a careful examination with the finger will disclose the presence of a pedicle to which the growth is attached. Polypus of the rectum is likely to be confounded with hæmorrhoids or prolapsus of the rectum, but a careful inspection and examination of the parts will disclose the nature of the trouble. Before examining a case of suspected polypus of the rectum it is well to give an enema, and when this is passed the growth is apt to be brought to the lower portion of the rectum or may present at the anus. In examining for polypus it is well to introduce the finger as far as possible into the rectum, and, as it is withdrawn, to make the examination of the walls with a sweeping motion, by which manipulation the pedicle of the polypus may be hooked upon the finger.

Treatment.—A polypus of the rectum may be seized with the fingers or forceps and twisted off, and the stump may be touched with nitrate of silver or with nitric acid; but I think the better method of treatment is to grasp the polypus and draw it out of the anus, so as to expose its pedicle, and to surround this with a ligature close to the mucous membrane, care being taken not to make sufficient traction to invert the wall of the rectum, which might thus be included in the grasp of the ligature. The ligature should next be firmly tied, and the tumor removed by dividing the pedicle in advance of the ligature. If a number of polypi exist, the same procedure should be repeated for each growth.

Angeioma or Nævus of the Rectum.

This is also a rare affection. Mr. Howard Marsh has reported the case of a girl ten years of age who suffered from rectal hæmorrhage, in whom an examination revealed a nævoid growth in the lower portion of the rectum; and Mr. Barker has also published a case of this nature.

Treatment.—The treatment of nævus of the rectum consists in the use of

the ligature to strangulate the growth, or the application of nitric acid or Paquelin's cautery.

Malignant Disease of the Rectum.

Malignant disease of the rectum is very rarely met with in childhood, but may occur either in the form of cylindrical-celled carcinoma or of sarcoma. Allingham, Quain, Cripps, and other observers have reported a few cases occurring in childhood.

Treatment.—The treatment consists in the excision of the growth if its situation be favorable for such a procedure; or linear rectotomy, which consists in freely dividing the growth together with the lower portion of the rectum, including the sphincter, may be practised with benefit, if obstructive symptoms are present. If the growth involves the high portion of the rectum and excision is not possible, colotomy should be performed.

Wounds of the Rectum.

Wounds of the rectum may be caused by substances which reach the rectum through the alimentary canal, or by bodies introduced through the perineum or the anus; these wounds may be lacerated, incised, or punctured. Lacerated or punctured wounds may result from patients falling upon sharp bodies which enter through the perineum or anus, or from fragments of broken bones of the pelvis, causing in many cases extensive laceration of the parts about the rectum as well as of the rectum itself; they may be complicated by injuries of the bladder, vagina, or peritoneum. Lacerated wounds of the rectum may also result from the careless or forcible introduction of the nozzle of an enema-syringe; and laceration of this organ in children who have been subjected to unnatural intercourse should also be mentioned. Incised wounds of the rectum may result from operations upon this organ or from its accidental incision in the operation of lithotomy.

Treatment.—The treatment of incised or external lacerated wounds which involve only the lower portion of the rectum consists in controlling bleeding by the application of ligatures to the bleeding vessels; in washing the wound thoroughly with a solution of bichloride of mercury, 1:4000; in dusting the wound with powdered iodoform; and in providing for the escape of discharge by the introduction of a drainage-tube or catgut drain, and in bringing the edges together with catgut sutures. A gauze dressing should then be applied, and the bowels kept quiet for a few days.

In punctured or internal lacerated wounds of the rectum which do not extend high enough to involve the bladder or peritoneum it is better, in order to secure free drainage, to convert the internal punctured or lacerated wound into an open wound by the division of all the tissues, including the external sphincter and the skin. The wounds should then be washed with a solution of bichloride of mercury, packed lightly with iodoform gauze, and allowed to heal by granulation, the dressing being changed as often as it becomes soiled.

In a case of lacerated wound of the rectum complicated by wound of the bladder, perineal cystotomy should be performed to provide for the free escape of urine, and free drainage secured by division of the anal sphincter and the introduction of drainage-tubes if necessary. If a punctured wound of the rectum involves the peritoneum, with injury to the contained viscera, laparotomy should be performed, the wounds of the viscera should be sutured, and the peritoneal cavity irrigated, drained, and closed.

Foreign Bodies in the Rectum.

Foreign bodies may enter the rectum from the alimentary canal or may be introduced through the anus. A great variety of foreign bodies have been thus introduced either by accident or design. Patients suffering from foreign body impacted in the rectum will have ineffectual attempts at defecation, with the passage of mucus, which is often blood-stained. In a case presenting these symptoms a careful exploration with the finger will enable the surgeon to ascertain the presence, the exact location, and the character of the foreign body.

Treatment.—The removal of the foreign body should be accomplished with the least possible injury to the walls of the rectum. It is well first to anæsthetize the patient, and then inject into the rectum a few ounces of olive oil. When the character and position of the foreign body have been ascertained, it may be dislodged with the finger and removed by forceps. Where the body is irregular in shape or possesses sharp edges or angles which may cause injury to the surrounding parts, retractors or a bivalve speculum should be introduced to secure free dilatation of the anus and lower portion of the rectum and facilitate removal without injury to the rectal walls. Where the foreign body consists of a large mass of inspissated material, fragmentation should be resorted to in order to secure its satisfactory removal. If the foreign body has remained in position for some time and ulceration has resulted from its presence, a solution of nitrate of silver, 10 grains to the ounce of water, should be applied to the ulcerated surface, and suppositories of iodoform should also be introduced into the rectum. Extensive ulceration of the rectum following the long-continued presence of a foreign body may be followed by stricture, and the possibility of this condition should be guarded against by judicious dilatation by the finger or bougies.

PART VII.

DISEASES OF THE NERVOUS SYSTEM.

SIMPLE CEREBRAL MENINGITIS.

By THOMAS S. LATIMER, M. D.,

Baltimore.

By simple meningitis, leptomeningitis, or purulent meningitis, is usually meant inflammation of the arachnoid and pia mater. Writers distinguish an arachnitis, but as this probably never occurs apart from inflammation of the pia or dura it may be considered an unnecessary refinement. Varieties are mentioned dependent on the situation, grade, or nature of the inflammation, and whether primary or secondary, or according to the character of the exciting cause. All practical purposes are subserved by dividing simple meningitis into acute, subacute, and chronic forms, whilst considering in their appropriate places those peculiarities in each form incident to locality and origin.

All forms of meningitis have much in common, and a description of any one form is in great part a description of all; more especially is this the case in the clinical history and in the treatment; it is therefore expedient, to avoid needless repetition, which the space allotted to this article does not permit, to discuss the pathology and etiology of the different forms, and subsequently the clinical history and treatment, which are essentially the same in all.

Simple cerebral meningitis may be defined as inflammation of the arachnoid and pia mater of non-tubercular origin.

Etiology.—Simple meningitis is said to occur in utero (Guersant) and to be quite frequent in the new-born. According to Ramskill, its period of greatest frequency is prior to the second year, becoming less so from that time until after fourteen, when it again becomes more common, especially between sixteen and forty-five. Gowers places the period of greatest frequency between the ages of one and ten years, including, however the tubercular form. It is essentially a disease of early childhood, and is more common than is admitted by those who refer all basilar inflammations to a tubercular origin. In the post-mortem observations of Drs. Gee and Barlow, recorded in *St. Bartholomew's Hospital Reports* for 1878, are 6 cases of non-tubercular meningitis, and in 41 post-mortem examinations by Dr. Goodhart, in cases which he says without examination would have been set down as tuberculous, 8 were non-tubercular.

Sex may be admitted among the predisposing causes, since Parent-Duchatelet and Martinet found it to be three times as frequent in males as in females. The occupations peculiar to men and the sports of boys, involving exposure to vicissitudes of weather and to mechanical violence, may account in great part

for this difference, without assuming that there exists any liability or immunity due to sex *per se*.

Injuries to the head, extension of middle-ear inflammation or of any adjacent disease, the special cause of many specific diseases, like pneumonia, scarlatina, erysipelas, and measles, ordinary pus-producing organisms, emboli and thrombi —may all be exciting causes. An inherited or acquired predisposition is perhaps not uncommonly present, but less often than in the tubercular form. Rheumatism has been supposed to be a frequent cause, but its importance has doubtless been over-estimated. Symptoms closely simulating those of meningitis often arise in the course of acute rheumatism when post-mortem examination reveals no trace of inflammation. Trousseau absolutely denied the inflammatory nature of these cases, which he called neuroses. Two of the most characteristic symptoms of meningitis, vomiting and headache, are also commonly absent. Doubtless rheumatism is sometimes a cause of true simple meningitis, but all the symptoms may arise from hyperpyrexia alone. Suppurative endocarditis or any other septic trouble may occasion it, as in the cases following operation for imperforate anus referred to under Pathological Anatomy. Those cases arising from adjacent disease may be limited to the convexity, while those occurring in the course of acute specific diseases may affect the base also, though a preference for the convexity is recognized in all non-tubercular forms.

Pneumonia is frequently associated with simple meningitis and the pneumococcus is found in the inflammatory exudate. Huguenin states that at Zurich it is a frequent complication of pneumonia, and Chvostek found it four times in 220 cases in Vienna.

The most common cause of this affection is extension from some local adjacent disease; middle-ear inflammation is a frequent antecedent. Cases have occurred in which suppuration of the eyeball was primary, the inflammation extending along the sheath of the optic nerve. In some instances no immediately exciting cause is apparent. Fagge relates several cases occurring in Guy's Hospital in which a diseased temporal bone was found post-mortem, but the meningeal inflammation appeared to start in one instance from a blow with a bolster, and in another an attack of sunstroke preceded the cerebral symptoms about seven days. Moxon gives a prominent place to syphilis as causative of meningitis, and Fagge says 5 cases, in which it occurred without other syphilitic lesions within the calvaria, were found among the records of Guy's Hospital. This writer appears to approve the notion that the direct rays of the sun may produce simple meningitis, or that even its reflection from the pages of a book while reading is a sufficient cause; but this is scarcely credible.

Pathological Anatomy.—When death occurs in the early stage of leptomeningitis, intense hyperæmia with extreme dryness and opacity of the membranes—from distention of the lymphatic sheaths of the vessels—over the whole or part of the brain may be the only lesion. If death occur after a few days' duration, effusion of fluid admixed with cellular elements will be found on the arachnoid, in its sac and infiltrating the pia mater. Abercrombie relates a case in which it was so abundant between the dura and arachnoid as to distend the anterior fontanelle. Usually, however, the quantity of fluid exudate is not large. When life has been prolonged to the fifth or sixth day, the quantity of fluid is sensibly diminished, and a little later disappears. A membrane-like deposit of yellowish hue is found on the arachnoid; the pia in greater or less part is covered and infiltrated with "concrete pus," which is also found around the vessels and in the sulci of the convolutions (Ramskill). The nerve-

sheaths may be reddened and bathed in semi-purulent lymph, which at times is punctiform and resembles tubercular granulations. In long-standing cases this may undergo caseation or induration. The nerve-trunks may be in different stages of hyperæmia, softening, and disintegration. The dura and arachnoid may be firmly adherent, the arachnoid and pia almost always.

The ventricles may be invaded, their lining membrane inflamed, the orifices of communication occluded, and the chambers distended with serum or pus, sometimes to the extent of producing a true hydrocephalus. In rare cases they may contain false membrane. More frequently they contain a flocculent fluid of variable quantity, sometimes sufficient to distend the ventricle and compress the cortex. The subjacent brain-substance may be œdematous and softened. This condition is not always associated with unmistakable evidence of inflammation of their lining membrane; indeed, the inflammatory changes in the ventricles are rarely, if ever, well marked. In those cases where inflammation is most pronounced the effusion is seldom limited to the ventricles, but may invade the cord and escape into the brain-space. Great distention of all the ventricles may occur without inflammation, from simple occlusion of the channels of communication with the space around the brain (Gowers). Rilliet relates a case in which the convexity of one side was covered with false membrane, whilst the pia of the opposite side was simply œdematous.

Cases of pneumonic origin are usually bilateral and limited to the cortex; those extending from local foci—purulent otitis, caries, etc.—are unilateral, and may be associated with thrombi of the sinuses or with abscess (Osler). Septic cases and those associated with specific diseases are apt to be bilateral. The base is often involved in the inflammatory process. An interesting case of basilar meningitis following an operation for imperforate anus, reported by W. T. Howard, Jr., in a child of three months, is related in Osler's *Practice of Medicine*, in which the ventricles were distended with pus containing a coccus and the bacterium coli commune; the ependyma was softened and infiltrated with pus. Dr. Hilton Fagge also reports a case, occuring in Guy's Hospital, of a meningeal inflammation following six days after an operation for imperforate anus, attributed to sepsis, though the meningitis was the only evidence of pyæmia. Dr. Fagge says the presence of subdural pus may usually be taken as an evidence of extension from without, though in many cases no subdural pus is found. The pia is usually swollen and œdematous, filling the sulci; the inflammation may extend along the vessels to the cortex, which becomes infiltrated, softened, and so adherent at times that the pia cannot be removed without cortical laceration. The whole surface of the cortex may be bathed in pus or deeply infiltrated with leucocytes, and Huguenin says "suppuration of the brain-substance may reach such a point as to give rise to a diffused yellow-gray maceration visible to the naked eye" (quoted from Fagge's *Practice*). The amount of blood in the vessels may be greatly diminished from pressure of the exudate and thickening of their walls.

Symptoms.—Simple meningitis of childhood usually begins abruptly with well-marked rigors. Prodromic symptoms are much less frequent than in the tubercular form. The patient is petulant and irritable when disturbed, but inclined to apathy at other times, more especially in later stages and when the convexity is especially involved. Violent delirium with or without convulsions may be an early symptom. When convulsions occur early, they are apt to recur often during the progress of the trouble. The delirium may be quiet and the convulsions slight or absent. Pyrexia quickly supervenes, and is usually high: a temperature of 103°–105° F. is not uncommon in the first week. It is sometimes very slight, occasionally scarcely appreciable, and in the last stage

the temperature may be subnormal. The pre-mortal temperature is sometimes as high as 106°–108° F.

The pulse may be frequent and tense, usually so in the beginning, or slow and irregular, sometimes as slow as 60, 50, or 40 per minute, or just before death it may rise to 160–180 per minute. Henoch considers an intermittent pulse characteristic of meningitis. It is of more significance in childhood than in infancy, but at no time has it the diagnostic value imputed to it. The extreme variation in frequency and quality of the pulse is probably its most significant character.

Respiration is usually but little disturbed, but is sometimes sighing, may be quickened at first and subsequently irregular and slow, and toward the close the Cheyne-Stokes rhythm may be present. When the lesion is in the posterior fossa, respiration is slow, labored, accompanied by cyanosis, and may stop suddenly.

Headache is perhaps the most constant symptom, and is seldom lacking. It is often associated with great tenderness of the scalp and subjacent region, and is sometimes circumscribed, but the localization bears no constant relation to the site of the inflammation. The meninges of one side may be inflamed and the pain and tenderness be on the other; but when the pain persists in a circumscribed area it commonly indicates the site of the inflammation. Cases of simple meningitis sometimes run their entire course without pain, and when pain is present it seems to have no constant relation to the intensity or extent of the inflammation.

Hyperæsthesia of the nerves of the special senses of sight and hearing, indicated by extreme aversion to light and noise, is almost invariably present. This may be associated with acute general hyperæsthesia. The pupils are at first contracted; as the photophobia diminishes they become irregular; one may be contracted and the other dilated, or at times contracted, at times dilated; finally, both become dilated and vision is impaired or lost; optic neuritis is present in many cases, especially when the base is involved. Noises at first greatly disturb the patient. This sensitiveness to sound is at times so great that the most softly modulated speech occasions signs of petulance and distress. As the end approaches this gradually passes away, and deafness may ensue.

The intelligence is sooner or later affected; the patient is irritable and petulant when questioned or otherwise annoyed; incoherent speech and delirium are often early symptoms. Other nervous symptoms present at this time are subsultus, carphologia, inco-ordinate efforts at locomotion if this be attempted, and projectile vomiting.

The tache cérébrale is well marked, but is without diagnostic significance. Occasionally the patient emits short, sharp cries that do not always appear to be due to pain, though in older children they often seem to increase the headache.

General convulsions may occur independently of the site (Gowers), and eventually give place to coma. Rigidity of the muscles of the neck, with retraction of the head, is an early symptom of diagnostic value; it is more frequent in inflammation of the base than of the convexity. When the base is the site of the lesion, local spasm may occur in simple as well as in tubercular meningitis. Rolling up of the eyes, oscillations of the globes, strabismus, most marked when the eyes are moved, are frequently present in the first stage; later they may give place to paralysis, sometimes limited to the face or a small part of it, sometimes to a single extremity; or complete hemiplegia is present.

Vomiting is so commonly present and of such distinctive character as to possess diagnostic significance. It is projectile, unaccompanied by gastric pain or tenderness, nausea, or retching. It may persist throughout the disease, but is most characteristic in the early stage. It occurs independently of the site, but is more common in inflammation of the base. It is not present in all cases. The tongue is usually somewhat furred, but presents nothing characteristic. The bowels are constipated in a large proportion of cases, and the abdomen is retracted or boat-shaped.

Finally, all the active symptoms subside; the headache, photophobia, acoustic sensibility, general and local hyperæsthesia, and active delirium, all give place to coma and general collapse. The pupils are dilated, the pulse weak and irregular and the skin cold and clammy. Cheyne-Stokes respiration is established, the sphincters are relaxed, the fæces and urine are voided involuntarily, and death speedily ensues.

Subacute Leptomeningitis is peculiar only in the relative mildness of the lesions and the slowness with which it develops. It sometimes, though rarely, succeeds to the acute form, but more commonly is subacute from the beginning. The same lesions of milder grade are present, and are due to the same exciting and predisposing causes.

Hydrocephalus is perhaps more frequent and extensive; active delirium is frequently substituted by a more quiet form and a condition of mental torpor. The patient is less irritable, the photophobia and acoustic sensibility is less, and paralyses are slower to appear. There is but little propriety, however, in recognizing a subacute form; it is merged by such insensible gradations, on the one hand, into the acute, and on the other, into the chronic form, that there is little to distinguish it.

A latent form is also described, but in the judgment of the writer it has no well-established claim to recognition, and will not therefore receive further consideration.

Chronic Leptomeningitis. — Chronic leptomeningitis may succeed the acute form, but is of extreme rarity except as a result of syphilis or chronic alcoholism, causes not likely to occasion it in childhood except through inheritance.

The symptoms are less clearly distinctive, and the difficulty in diagnosis therefore greater, than in the acute form; consequently it may often be overlooked and the frequency of its occurrence underestimated. If, as Goodhart has remarked, we accept cervical opisthotonos as evidence of meningitis, it may not only be very chronic, but also intermittent, and, we may add, more frequent than commonly supposed.

Its clinical history is not to be separated by sharply-drawn lines from that of the acute disease. It is essentially the same in character, but of slower development and more protracted stay, and all the more characteristic symptoms are of less intensity. An apathetic condition with headache and a disposition to vomit, a pulse at first slow, soon becoming quick and irregular, double vision, strabismus, and irregularity of pupils, may usually be found if sought for. The favorite site of chronic infantile meningitis is the posterior fossa, and the most characteristic symptoms are local and dependent on the seat of the inflammation. Drs. Gee and Barlow observed cervical opisthotonos in most cases. In some cases of rapid development it may be attended or preceded by convulsions, vomiting, pain, and fever; in others the retraction of the head is slowly induced, unattended by these phenomena. Rigidity of the limbs and epileptic convulsions may occur later, together with oscillations of the globe or strabismus, and occasionally hydrocephalus (Gowers). When the orifices of

the fourth ventricle are closed with lymph, paralyses, facial and hemiplegic, may complicate the later period. The pia is usually thickened from increase in its connective tissue; a similar condition is found in the walls of its vessels, and from them may extend to the cortex, inducing such changes as may lead to insanity and idiocy. The pia and arachnoid may be glued together, œdematous and opaque, and the sulci be filled with serum or sero-purulent fluid or œdematous membrane. The Pachionian bodies are increased in number and size.

Chronic lepto-meningitis is much more frequently associated with syphilis than is the acute form. A swollen and œdematous optic disk, or optic neuritis, may aid the diagnosis, but cannot confirm it.

One is a little at a loss to understand why the cause of the meningitis should be supposed to determine a difference in the symptoms, except in so far as these are due to associated disease. The extent, intensity, and locality of the meningeal inflammation, with the nervous susceptibility of the individual, will determine the symptoms, which will be much the same whatever the cause.

Diagnosis.—The positive indications of simple meningitis are found in the symptoms already mentioned, though they may any or all of them occur without meningeal lesion of any kind whatever. The general cerebral symptoms are valuable according to their degree and combination, rather than by their mere presence. "The significance of the headache depends on its intensity; of the delirium, on its coexistence with headache; of vomiting, on its causeless character and persistence; of general convulsions, on their association with other symptoms; of infrequency of pulse, on its combination with pyrexia that usually accelerates the heart" (Gowers). It is not to be distinguished by its symptoms from tubercular meningitis, though in general it may be said to be more frequently dependent on some pre-existing local disease, to be more abrupt in its invasion and rapid in its progress in acute cases, and to be more frequently associated with active delirium. It is probably more dependent on some local lesion or association with specific disease than is the tubercular form. In the latter the presence of the tubercle bacilli or of septic materials from degenerating tubercles, with peculiar susceptibility, is alone sufficient for its development. The presence, therefore, of tubercle in other organs, the detection of tubercle bacilli, and a tubercular family history are of greater value in the differential diagnosis than any supposed difference in symptoms directly due to the meningitis. Though clear evidence of tubercle elsewhere may be wanting, slow invasion, early childhood, and the absence of distinct local cause make for a tuberculous origin. When the base alone is the site of the inflammation, the probabilities are strongly in favor of the tubercular form. Inflammation of the middle ear or labyrinth, with or without suppuration, may give rise to symptoms that cannot be distinguished, except by their duration, from meningitis. The detection of an otitis, therefore, may lead us to believe in the existence of meningitis originating from it, or to hope that the symptoms are solely due to it and will end in recovery under proper treatment. And in cases that recover under such circumstances, the diagnosis must remain permanently in doubt, since many cases of simple meningitis have been thought to recover.

It is also not altogether unlikely that the characteristic symptoms may arise as a reflex result of lesions of the most varied character in remote parts of the body. From the cerebral form of pneumonia simple meningitis may be distinguished by the physical signs of the former and the detection of the pneumococcus. But it must be remembered that although pneumonia may exist without meningitis, with analogous cerebral symptoms, yet pneumonitis and true meningitis may coexist and be due to the same cause. I know of no way to

distinguish cerebral symptoms occurring in pneumonia without meningitis and those occurring under like circumstances with it, except by their duration; and even this in many cases is the same, since pneumonia with marked cerebral symptoms often runs a speedily fatal course. Perhaps, instead of trying to differentiate them, it would be best to consider both as local expressions of the same constitutional state.

Pyæmia may present symptoms closely resembling meningitis, especially when associated with thrombus of the lateral sinus and jugular vein, as in a case reported by Dr. Frederick Taylor. Dr. Wilson Fox also relates a similar case, and Dr. Andrew two instances of pyæmia with cerebral symptoms not distinguishable from meningitis; both of these recovered, however, so it cannot be said they were not cases of true meningitis, unless it be assumed that acute simple meningitis never recovers.

Those cases of typhoid fever likely to occasion difficulty in diagnosis are characterized by the predominance of cerebral symptoms and the absence or slight nature of those peculiar to the alimentary canal; but in typhoid fever headache precedes delirium, usually ceases with its advent, and is sufficiently accounted for by the pyrexia—not so in leptomeningitis. Photophobia and auditory hypersensibility may occur in either, but they are far more acute in meningitis. In typhoid fever vomiting seldom has the distinctive cerebral character, and rigidity of the neck and local paralyses seldom occur. The invasion of typhoid fever is rarely so abrupt; the pulse is not so irregular.

Prognosis.—In all cases of leptomeningitis but little hope can be reasonably entertained of recovery when no error in diagnosis has been made; but errors of this kind happen in the experience of the most astute and well-informed physicians. Moreover, cases apparently free from doubt have recovered in sufficient number to warrant hope, but hope only, for nothing in the condition of the patient serves as a reasonable basis for expectation of recovery. The cases which do best are those having their origin in injuries, necrosis, caries, suppurative otitis, and other removable causes, and those that arise in the progress of syphilis. The majority even of these will terminate fatally after the inflammation is well established, but much may be done, by the early removal or correction of such causes, to prevent the establishment of meningitis. Those in which the indications are that both the convexity and base are affected run a rapidly fatal course. Patients in whom no reasonable cause exists may be expected to succumb, more especially if the pulse soon becomes irregular and weak, accompanied by nausea, with convulsive seizures followed by profound hebetude.

When light and noise no longer disturb; when the pupils become persistently dilated; the skin cold, pale, and bathed in perspiration; when involuntary evacuations occur; paralysis local or general becomes established, and coma or a semicomatose condition supervenes,—all hope may be abandoned.

Treatment.—The treatment in simple cerebral meningitis and in simple cerebro-spinal meningitis is essentially the same. A much larger proportion of cerebral cases are due to local conditions that may be treated by surgical measures, and whenever they do arise from removable causes surgical treatment should be instituted without delay. Suppurative otitis, with or without necrosis or caries of the temporal bone, is so often causally related to meningeal inflammation that these lesions should always receive efficient attention before the induction of the graver evil. It has happened to the writer to witness two cases of supposed leptomeningitis in adults, with fatal terminations, supervening on chronic suppurative otitis that had followed scarlatina many years before. Had the aural trouble been efficiently treated, the meningeal inflammation

would in all probability have been averted. Doubtless many similar cases have existed, and, in view of the great fatality of the secondary affection and the impunity with which surgeons of the present day invade the meninges, and even the substance of the brain, they should in future disappear from our records. All cases of injury to the skull that carry with them even a reasonable suspicion of injury to the meninges or brain should, in the judgment of the writer, be trephined, bone-fragments elevated or extracted, blood-clots removed though the membranes have to be incised for that purpose, and all the parts thoroughly cleansed. Analogous procedures are no less imperatively called for in diseased conditions than after injury.

Cases of syphilitic origin should receive the specific treatment proper to that disease, with a not unreasonable hope of recovery if the treatment be begun early.

Apart from these special indications for treatment, there is but little to be expected from any means at our disposal beyond the alleviation of suffering. Drugs appear to exert no influence on the course of the disease, and it may be doubted, even in those cases of supposed leptomeningitis that have recovered, whether the remedies administered have contributed to this result.

Bleeding, local or general, and blisters are still strongly advocated by German writers and by many others. Apart from relief of hyperæmia of the cerebral vessels, one sees but little benefit to be derived from them, and it would seem that this might be better accomplished by such remedies as amyl nitrite, which increase the vascular area and so lower blood-pressure without the same impairment of strength as follows bloodletting. Mercury and the iodide of potassium have been warmly and ably advocated as efficient therapeutic agents in this disease, but they so often appear to be entirely without effect that the writer is sceptical of their value except in cases of syphilitic origin. Nevertheless, excellent results of treatment with these agents have been reported by most competent observers. Ramskill in Reynolds's *System of Medicine* thus summarizes the treatment: "It resolves itself into three great remedial measures: first, bloodletting; second, hard purging; third, applications of cold water or ice to the head."

Abercrombie's cases also give strong support to the efficiency of these measures. Case 69, aged eleven, after an illness of five or six days was in a comatose condition, notwithstanding free purging, blistering, and the use of mercury to salivation; was immediately relieved and made a good recovery after one bleeding from the arm. Case 72, aged twenty-one years, was reduced to a condition of stupor from which he could scarcely be roused, and continued in this way for eight or ten days notwithstanding repeated bleeding, blisters, and cold applications. But, after taking full doses of castor oil every three hours until purgation was induced, he was on the same evening relieved and made a good recovery (quoted in Fagge's *Practice*).

A brisk purge in the beginning and from time to time during the progress of the trouble will do much to alleviate suffering, and at times seems to have a decidedly beneficial effect. Cases, not a few, are recorded, especially by the earlier writers, which seem to date improvement, rapidly progressing to recovery, from such measures as free catharsis, bleeding, local or general, blisters applied to head or back of neck. Whilst it is difficult wholly to discredit such statements or to deny to the agents employed the remedial potency claimed for them, yet it is equally difficult to conceive how with such means such ends could be attained. When remedies of this class are serviceable at all, it must be in the early stage before inflammatory exudation, infiltration, or degenerative changes have occurred to any notable extent; and one cannot wholly

shake off the doubt that they were cases of erroneous diagnosis, or at least belong to that rare class of cases that would have recovered without medical interference.

An entirely different class of remedies is found in those drugs of anodyne and hypnotic properties which allay vomiting, soothe pain, subdue or lessen active delirium, procure sleep, and contribute in many ways to make tolerable for patients and friends the last days of those for whom in a large majority of cases we can hope to do no more. And, in the opinion of the writer, relief in these particulars is the extent of the power of drugs to be useful in this disease. First rank in this group of remedies may still be boldly claimed for opium and its derivatives, and especially for morphine, which, because of the small dose required, the facility with which it may be administered hypodermatically, and its almost uniform strength and efficiency, takes precedence of all other drugs. The bromides of sodium and potassium, antipyrin, antifebrin, sulphonal, and many other similar remedies are at times of great usefulness. The occasional use of chloroform by inhalation when convulsions occur gives prompt relief to some of the most distressing symptoms, and is, I believe, as free from danger as any other remedy when judiciously employed; but nothing can be so confidently relied on to relieve pain, to procure sleep, to quiet delirium, and to arrest vomiting as morphine; and this it does at as little cost to a feeble heart as any other drug that may be used; nor do I think is the tendency to coma materially, if at all, increased by its judicious administration. But more valuable than any of the remedies yet mentioned is repose of body and mind as perfect as may be had by the mere exclusion of disturbing causes. The room should be darkened; no one not indispensable to the comfort of the patient should be admitted; no loud talking or other noises should be allowed within hearing; and no needless questioning by anxious friends. In cerebral cases the head should be shaved as soon as the nature of the trouble is clear. Ice or ice-cold water should be almost continuously applied to the head and—in cerebro-spinal cases—to the back. It should be begun early and continued steadily, and in cases of active delirium this may be supplemented by iced applications to the large arteries—brachials and carotids.

When coma appears, all depressing remedies should cease, although occasional recoveries are recorded even in this stage, as in Abercrombie's cases, already quoted, and in Sir Thomas Watson's case of recovery on the application of a blister to the entire shaven scalp after the appearance of coma. It is certainly more reasonable to expect good from the judicious use of stimulants in this stage or at any time when the heart-beat is feeble or intermittent. Throughout the disease, as far as practicable, the strength of the patient should be maintained with the most nutritious diet.

SIMPLE CEREBRO-SPINAL MENINGITIS.

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Simple or Sporadic Cerebro-spinal Meningitis occurs under precisely the same circumstances as simple cerebral meningitis, and is attended by the same lesions, except in so far as the anatomical and physiological characteristics of the part invaded necessitate a difference. Nor can it be maintained in the present state of knowledge that any essential difference exists between this and other forms of cerebro-spinal meningitis. The tendency of recent observations and opinion is to the conclusion that epidemic cerebro-spinal meningitis (cerebro-spinal fever) has its origin in a specific germ, probably the diplococcus lanceolatus, and observations have not yet sufficiently multiplied to enable us to say whether or not this organism is also present in all sporadic cases. However this may be, it is clear that the two forms arise under somewhat different circumstances, and present such clinical differences as may be seen in other diseases, such as dysentery, that prevail at times epidemically and at times sporadically—differences chiefly of intensity in the symptoms and in the extent of the lesions, the epidemic prevalence implying a concurrence of suitable conditions in the individual and in the auxiliary associated conditions by which he is surrounded, and not necessarily any difference in the immediate exciting cause. In this restricted sense, then, we may still speak of simple cerebro-spinal meningitis as distinguished from cerebro-spinal fever. There are also cases occurring from injury, from sepsis, from local extension, from tuberculosis or syphilis, that probably have no causal connection with the pneumococcus, and may with more propriety be designated "simple" than may sporadic cases that appear to be closely connected with this particular organism.

Etiology.—The causes of simple cerebro-spinal meningitis are precisely the same as those of simple cerebral meningitis, and need not be again considered. They are injuries, extension from adjacent disease, pyæmia, specific diseases, childhood, sex, season, vicissitudes of temperature, and those general malhygienic conditions that predispose to inflammations in general. Meningitis is not, however, limited to any class, and may occur among the rich and poor alike. Efforts have been made to connect it with particular articles of food, but without much success. Fatigue from over-exertion seems to be a favoring condition observed most frequently in the adult.

Pathological Anatomy.—This disease may be an extension from simple cerebral meningitis, in which case the anatomical changes heretofore described in basilar inflammation will be present, and to them must be added those due to invasion of the meninges of the cord; or it may originate in the cord and extend up to the cerebral meninges, which would not of course alter the nature of the lesion, only the order of occurrence of its symptoms; or it may occur simultaneously in both regions, the anatomical characters remaining the same. These characters are—great hyperæmia in the first stage, to which soon suc-

ceed swelling and hypertrophy of the walls of the vessels of the pia mater sometimes also of the brain and cord, and with this œdema and cellular infiltration of adjacent parts may coexist. Sometimes the exudate may be small in amount and consist of serum, white corpuscles, and plastic material, by which in the last stage, if the patient survives, the membranes may be bound together, or the pia and surface of the brain or cord; or it may be of large quantity and purulent, filling the canal and bathing the pia and underlying structures in a grayish-yellow or distinctly purulent fluid, which may fill the entire space between the dura and arachnoid. The infiltration may occasion opacity of both pia and arachnoid. The spinal meninges are usually extensively involved, owing probably to the readiness with which septic elements are diffused in the spinal fluid. The spinal fluid is more or less flocculent from the presence of exudation elements, or it may be, as before said, distinctly purulent. A true myelitis may, and not unfrequently does, coexist, in which case paralyses occur of a more permanent character than when the meninges alone are involved. The arachnoid is probably never affected alone, but it is always involved in the inflammation, which may also extend to the dura and to the spinal nerves, to which latter circumstances some of the most characteristic spinal symptoms are due; but they by no means always share in the inflammation. According to J. Simon, the meningeal inflammation may usually be looked upon as an index to the more important changes that occur in the cerebral and spinal tissue, "and hence it is that the essential phenomena of the disease during life consist in disturbances, more or less grave, of the functions of these all-important organs."

Other organs and tissues present little or no pathological change, except perhaps the skin, and the lesions here found are commonly limited to the fulminant cases, which are found almost exclusively in the epidemic form of meningitis, and have therefore been fully described in another section.

Symptoms.—In this affection the convexity is seldom involved, and the symptoms are for the most part those characteristic of inflammation of the base and of the cord, more especially of the cervical region of the latter. The special senses are not affected to the same extent as in cerebral meningitis, although vision is sometimes impaired; irregularities of the pupil and strabismus, with oscillation of the globe, are usually present in minor degree, but intense photophobia is rarely a marked symptom. Deafness is quite common, and may be permanent; in many cases it is due rather to inflammation extending to the labyrinth and middle ear than to direct lesion of the auditory nerve.

Optic neuritis is present in most instances when vision is affected, and may terminate in permanent blindness in cases that recover. Keratitis, retinitis, opacity and ulcerations of the cornea, and opacity of the lens may all occur, but are not characteristic. Pain is invariably present, especially in the occipital and cervical regions, and is associated with general cutaneous hyperæsthesia; all movements of the patient occasion suffering, associated with rigidity of the spinal extensor muscles, sometimes affecting also the muscles of the chest, abdomen, and jaws, producing a sense of constriction and slight trismus. This hyperæsthesia and muscular contraction is probably due to the involvement of the roots of the spinal nerves in the inflammatory process.

The retracted neck and back, at times amounting to decided opisthotonos, is in part voluntary, due to a disposition to relax, as far as may be, irritable muscles (Radcliffe); in part reflex, from irritation of the sensitive fibres of the posterior roots distributed to the pia; and in part from direct irritation of the anterior nerve-roots, or to all these combined. When the patient is perfectly

at rest, considerable intervals of almost complete relaxation exist, but all efforts to restore the normal decubitus are commonly attended with recurrence of the abnormal position and rigidity. Most intense pain in the head and cervical region is an early and continuous symptom; it seldom entirely intermits, but severe exacerbations are of frequent occurrence. Pain in the back and loins is often present—always when the lower segment of the cord is invaded. The thighs are flexed upon the pelvis and the legs upon the thighs. Firm pressure over the spinal column does not occasion pain, a point of distinction between meningitis and spinal irritation. Local paralysis with facial distortion is not infrequently present, and in the later stage the patient may become hemiplegic, which usually implies the extension of the trouble to the substance of the brain or cord. Active delirium generally exists, sometimes as an early symptom, occasionally associated with convulsions, frequently ending in coma. Reflex irritability is always present in the early stage, but is less marked than in tetanus.

Vomiting is a troublesome symptom in most cases, and is difficult to control. The vomit consists of ingesta, bile, or a glairy greenish fluid. The bowels are usually constipated and the abdomen retracted, but diarrhœa not infrequently occurs, with tympany. Whilst this paper is in progress the writer is attending a case of well-marked sporadic meningitis in which diarrhœa induced by purgation continues, together with decided tympanites. The tongue presents nothing characteristic. It may be unchanged, slightly furred, or covered with sordes in the last stage. Appetite is no doubt impaired, but the desire for food is controlled in a measure, owing to the trismus and cervical contracture which efforts at swallowing, together with the necessary movements, induce. Thirst is an invariable symptom and is with difficulty appeased.

Pyrexia is present to a very variable extent; it may be scarcely appreciable, or it may range as high as 105° and 106° F., and in the last stage is usually highest.

With pyrexia the usually febrile pulse and respiration are associated, but marked dyspnœa may be superadded from paralysis or rigidity of respiratory muscles when the dorsal region of the cord is included in the inflammation. In cases complicated with pneumonia additional respiratory difficulty may be due to this cause; this is, however, a rare complication except in the epidemic form. The pulse is almost always quickened, ranging from 80 or 90 to 120, and in the first stage may have considerable tension, which is lost at an early period, a diminished arterial tension being one of the characteristic features of the disease. Very much more frequent pulse is recorded, and at times it falls as low as 50, but these instances are altogether exceptional. The kidneys rarely show any distinct lesion, but the urine is often increased in quantity, and occasionally contains a small amount of albumin. Retention of urine from spasm of the sphincters or paralysis of the detrusor muscles is sometimes associated with reflex spasm and irritable attempts to urinate. Involuntary, not necessarily unconscious, voiding of urine and fæces also happens.

Diagnosis.—The positive indications of simple cerebro-spinal meningitis have already been mentioned. Briefly stated, they are headache, pain in neck, back, and loins, with general cutaneous hyperæsthesia, exaggerated sensibility to light and sound, irregular pupils, oscillations and distortions of the eyeball, followed at times by blindness and deafness, paralysis of cranial or spinal nerves, delirium, convulsions, and coma; vomiting without apparent gastric cause, obstinately persisting; trismus and cervical contractures which may extend to nearly all the muscles of the body; pyrexia of inconstant degree,

and respiratory labor of varying and uncertain extent. From the epidemic form it is to be distinguished by its sporadic occurrence, its less rapid progress, its perhaps more extensive involvement of the spinal membranes, its usually less acute course, and the comparatively infrequent cutaneous lesions, especially of purpuric or hæmorrhagic character. It probably is more frequently causally related to local troubles of eye and ear, bone lesions, trauma, and sepsis. Perhaps if a clear distinction is to be permanently maintained between the simple and epidemic forms, it will come to rest on the absence of the diplococcus lanceolatus in the former and its presence in the latter.

With typhoid fever it may be confounded, but the distinction is not difficult. The severe persistent headache and spinal pain, the cutaneous hyperæsthesia, the exaggerated sensibility of special senses, trismus, muscular contractures, uncontrollable vomiting, constipation,—all early symptoms,—are sufficient for diagnosis before the later symptoms of each make error impossible.

With tetanus it has little in common but retraction of the head and slight opisthotonos, trismus, and thoracic constriction. In meningitis the back is less bowed, less rigid, and the contracture less easily induced; the trismus is seldom severe, often wanting, and rarely persists, whilst in tetanus a touch or a breath of air induces rigid opisthotonos, and trismus is an early, severe, and persistent symptom. In doubtful cases, if any such occur, the detection of the micro-organism of tetanus will resolve the doubt.

Cases of tubercular origin are to be distinguished alone by the invasion of other organs and by the family history, a more protracted course and an initial period of latency, with a less acute career.

Prognosis.—This is always grave, but a fair proportion of sporadic cases recover under judicious treatment. When the symptoms relate chiefly to the cord, a reasonable hope may be entertained, but when paralysis of cranial nerves, stupor, Cheyne-Stokes respiration, coma, and collapse occur, the issue is no longer uncertain. In some instances death has ensued in five hours, in from twenty-four to thirty-six hours not infrequently, but this has always been in fulminant cases, which are rare in the simple form. In sporadic cases life may be protracted several weeks, and in subacute cases sometimes many months; the usual period is about from ten to twenty days. Cases that recover are of longer duration than those that terminate fatally, but even in favorable cases the patient may be maimed for life, blind, deaf, paralytic, or with intelligence permanently impaired. In young children and in adults near middle age the mortality is greater than in youth.

Death may be due to asthenia from continued suffering, bed-sores, and inability to partake of food; or it may be more rapidly induced by respiratory difficulty from involvement of the respiratory centre, or by associated pneumonia; or convulsions may be followed by coma, collapse, and speedy death.

Treatment.—The same treatment advised in cerebral meningitis is advisable in cerebro-spinal meningitis—*i. e.* perfect rest, exclusion of light and noise, of visitors, and all causes of disturbance; removal of the cause when known and practicable; the occasional use of a brisk mercurial or other purge; liquid food and stimulants administered per rectum if not retained by the stomach; free and continued use of cold to the shaven head and back—ice preferred; the careful but efficient use of anodynes, of which opium and its derivatives are best, and in the early stage such remedies as the iodide and bromide of potassium with ergot. When the affection is chiefly or wholly spinal, Bramwell speaks in terms of high commendation of the iodide, and of ergot in the second stage, and also of the use of blisters and of tincture of iodine applied along the spine in the region implicated. Pain, cutaneous hyperæsthesia, and muscular

contractures indicate sufficiently clearly the site of the inflammation by the correspondence of these symptoms with the distribution of the nerves whose roots are affected; attention to the bladder and rectum is of course always requisite. Paralyses may require special measures in accordance with the common rules of treatment, but Bramwell suggests caution in the use of electrical stimulation during the period of meningeal irritability.

TUBERCULAR MENINGITIS AND HYDROCEPHALUS.

By LANDON CARTER GRAY, M. D.,

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I. Tubercular Meningitis.

Tubercular Meningitis—sometimes also designated *basilar meningitis* from the frequency of its occurrence at the base of the brain, and sometimes *acute hydrocephalus* on far less sound grounds—is characterized by marked cerebral symptoms, due to the deposit of tubercular granulations in the pia mater: this usually consists of inflammation of the membrane, central cerebral softening, effusion into the ventricles, and, often, of more or less general tuberculosis.

Etiology.—The etiological factors of tubercular meningitis are heredity, tubercular infection, age, and erythema nodosum.

A tubercular heredity produces of course the tubercular manifestations in the different organs of the body, but there has never been produced any proof that tubercular meningitis is hereditary except in this general sense. Jacobi states that its origin can often be traced to the bronchial glands, in which tubercular degeneration may remain dormant for years, and through them whooping-cough or measles may act as an exciting cause of a general tuberculosis after years have elapsed from the time of the original infection.

Most cases are observed between the second and seventh years, but, nevertheless, it may occur at almost any period of life, and I have myself seen a case in a man of sixty, the diagnosis having been verified by an autopsy. Several cases have been reported as connected with erythema nodosum.

Pathology.—In tubercular meningitis the pia mater is the structure affected, so that the lesion may be said to be an inflammation of the pia, with deposit of tubercle, and this is to be distinguished from the simple non-inflammatory tuberculosis of the pia that is a frequent complement of general miliary tuberculosis affecting the different organs of the body. In children the pia at the base of the cerebrum is alone affected, whilst in adults there is a tendency to implication of the same membrane at the vertex. The favorite nesting-place of the affection is in that portion of the pia which extends over the olfactory, the optic, and the third nerve, as well as the crura cerebri. Changes, however, may be found throughout the pia at the base of the brain, and also as it extends into the choroid plexus and the third ventricle, as well as in that portion extending from the vermis cerebelli forward over the region of the corpora quadrigemina. This last site is of especial importance, as it contains the largest portion of the vessels which nourish the walls of the ventricles and the ependyma, thus explaining the constancy with which cloudy fluid is found in the ventricles, with softening of their walls. The branches of the Sylvian artery are also very prone to be affected, sometimes through the pressure of exudations surrounding these capillaries, sometimes through tuberculous

disease of a capillary wall, but most frequently by an obliterating arteritis. Over the quadrangle at the base the pia looks like wet blotting-paper, very much as it does in syphilitic meningitis. Elsewhere it is opaque and thickened, but it can usually be detached without tearing the cerebral substance. The exudation is abundant, gray, transparent, and gelatinous. In it are imbedded the tubercles, small grayish white masses, some scarcely visible to the naked eye, some the size of the head of a pin, and also of intermediate dimensions, and some so isolated as to form genuine tumors, which are usually, however, of small size. The cortex is in a condition of red softening, this extending to a variable depth, sometimes even through the whole extent of the white matter of a convolution; but occasionally white softening alone is seen. In this softened tissue caseous masses are occasionally studded; indeed, the usual cerebral tubercle is not much else than a conglomeration of widespread cheesy deposits. The tuberculous infiltration implicates the cranial nerves in varying degree. A section of the pia mater and the underlying tissue will demonstrate that the membrane is thickened, this increase in density often extending like a wedge into the cerebral substance; there is frequently thrombosis of the arterioles and of the venules of the pia, obliterating the lumen, and thickening of the capillary walls, which are often hyaline, surrounded by connective tissue and infiltrated with small round cells that have distinct nuclei; whilst farther away from the vessels, areas of reticulated tissue will often be seen. Many bacilli and granulations will be observed. Giant-cells are sometimes, though rarely, seen in the internal wall of the vessel and in the surrounding cerebral tissue, and the tuberculous bacilli are strewn throughout the vascular walls. The perivascular sheath is often dilated and filled with lymphatic cells.

Robert Koch first discovered the bacterium of tuberculosis. In tuberculous lesions in many organs, in sections of miliary tubercles, and in the sputa of tuberculosis he found certain fine and elongated bacilli which colored in a peculiar manner. In the giant-cells they were especially frequent. The observations of Koch have received confirmation by Gibbes, Lichtheim, Frenzel, Balmer, Charnley Smith, Heron, Ransom, Ernst, Shakespeare, Prudden, and many others. Koch's observations have been attacked by Spina of Vienna and other experimenters, but have not been materially weakened. Other bacteria have been found in tuberculous meningitis besides those of Koch. Babes examined twelve cases, and in seven discovered different microbes, this variety explaining, in his opinion, the purulent and acute nature of some cases. There were tuberculous lesions of the mediastinal ganglia in all these, and also often pulmonary lesions of the same nature. In two cases a lanceolated microbe was found; in another the ordinary streptococcus of pus; a staphylococcus aureus in a fourth; in the fifth a streptococcus of pus; and peculiar pathogenic bacilli in the two remaining cases. In one of these cases, a culture from which produced acute meningitis and death when introduced by trephining into the meninges of a rabbit, there was a fine bacillus closely resembling that of tuberculosis. Another microbe, resembling that of Friedländer, was found, and meningitis was also produced by it in the rabbit. Still another case showed a tetrahedric microbe in the pus, in groups like the staphylococci, but negative results followed its inoculation. A peculiar microbe which developed a colony in agar-agar was found in another case. Babes examined some other cases in which no microbe except that described by Koch was found. The same observer has also found a few tubercular bacilli in two cases of meningitis caused by purulent otitis.

Symptoms.—The prodromal symptoms, which may last one week or

several, consist of pallor, peevishness, listlessness, interrupted sleep, occasionally headache (which may awaken the child and be localized), coated tongue, occasional vomiting (which may be either propulsive or regurgitative), constipation, sometimes diminution of urine, occasionally slight hyperæsthesia of the abdomen, photophobia, and a tendency to emaciate. In the majority of cases the prodromal symptoms are present, but the number of them varies exceedingly from case to case, and the onset may sometimes be acute. As a rule, however, the continuance of these symptoms is significant, especially when it is coupled with a constant temperature somewhat above the normal and showing a tendency to rise slowly from 100° to 101½° F. It may be said that, on the whole, the febrile curve is that of the varieties of pulmonary phthisis; that is, ascending, with or without remissions. Thus a child may have a temperature a little above 99° in the morning, and in the evening somewhat above 101°, or the morning temperature may be a little above 100° and the evening 101½° to 103½°, or the morning temperature may be as high as 102° and in the evening 102½°. In this respect the febrile curve of tubercular meningitis does not have the remittency or the sharp curves characteristic of typhoid fever, and it is not apt to run so high. The pulse is at first slightly irregular, and gradually becomes much more so. Slowly more pronounced symptoms appear. The respiration becomes irregular, and the patient sighs deeply and long, the abdomen is retracted, the eyes half closed as in dying, and the eyeballs occasionally move slowly in a lateral direction. One or both pupils may dilate. The face flushes in patches, and the Trousseau mark may be observed—*i. e.* a red mark left upon the skin when the finger is pressed over it or when it is dented by the pillow—and friction causes a blush corresponding to the area rubbed. These general symptoms of cerebral implication are followed, usually somewhat suddenly, by such evidences of localized organic implication as slight twitchings around the mouth and eyelids, or a convulsion, usually generalized, succeeded by ptosis, amaurosis, strabismus, or paralysis of the face or extremities. When the extremities are involved, the type is usually a hemiplegia, although occasionally one extremity alone may be affected. The temperature now mounts to 102° or 103°, or even more, the head is drawn back, the pulse increases in frequency, and the symptoms may grow in intensity until death supervenes after a period of three or four weeks, the fatal event being usually preceded by Cheyne-Stokes respiration. In milder cases convulsions may not be observed until a few days before death, but in these types vomiting, headache, delirium, and convulsions are marked, and the abdomen may be tumid instead of retracted. In some cases, too, somnolence may be marked from the onset. Occasionally retinal hyperæmia or choroidal tubercles are observed.

Prognosis.—Tubercular meningitis usually proves fatal. A few cases of recovery have been reported by different writers, such as Abraham Jacobi and Hahn, the former of whom claims that he has seen two cases, but I have never met with favorable result.

Diagnosis.—When tubercular lesions previously existing in other organs are followed by the symptoms of tubercular meningitis, its diagnosis is easily made. The diagnosis may become difficult, however, when there is no pronounced hereditary history, and when there is no history of personal tuberculosis in the individual. Tubercular meningitis can be diagnosed in cases showing the prodromal symptoms of gradual change, conjoined with paralysis of extremities or cranial nerves, the retraction of the neck, the somnolency, delirium, half-open eyes, temperature rising to 101° and above, other lesions capable of causing similar symptoms being excluded. Such other lesions are:

cerebro-spinal meningitis, syphilitic meningitis, simple meningitis, trauma, typhoid fever, intracranial tumor, ear disease, the hydrocephaloid state, mental disturbances from pulmonary lesions, and uræmia.

When cerebro-spinal meningitis appears as an epidemic, it is of course easily diagnosed. In endemic or solitary cases the characteristic eruption may be present; the prodromal symptoms are usually short, and the vaso-motor disturbances produced by pressure upon the skin take place at an earlier stage.

Syphilitic meningitis in a child with syphilitic heredity will be accompanied by such well-known signs as early enlargement of the spleen, the characteristic rash, chronic snuffling, usually beginning soon after birth, and collapse of the bridge of the nose: it yields readily to mercurial treatment.

In simple meningitis the prodromal symptoms will be lacking, and it is more sudden of onset. There will be no history of predisposition or tuberculous infection, the temperature is higher, and the course of the disease is more quickly run.

In trauma the diagnosis may be easily made by the onset of a meningitis, or hæmorrhage succeeded by a meningitis, providing the trauma be known; or, in case no history of trauma is given, by the quick onset of the symptoms; and the general history will distinguish it from simple meningitis.

The diagnosis from typhoid fever, when non-typical, is almost impossible in the first week or ten days, but when typical the temperature curve will distinguish it.

In intracranial tumor in a child or adult the symptoms will be much more localized, more prolonged, and will not be marked by a rise of temperature.

Ear disease should be carefully searched for in cases of meningitis where the symptoms are not clear, and the diagnosis may be made plain by the discovery of a purulent discharge.

In the hydrocephaloid state so many of the symptoms of meningitis may be present that the diagnosis may be in doubt for a time, but the nature of the case will soon be made evident by the history of some acute disease, particularly some gastro-enteric trouble, having preceded the brain-symptoms.

Pulmonary lesions, especially in a child, may produce brain-symptoms closely simulating a meningitis, but the diagnosis may be made clear by auscultation and percussion of the lungs.

A careful examination of the urine will make the diagnosis in uræmia; the organic symptoms present in a meningitis are also lacking.

Treatment.—Although the prognosis of tubercular meningitis is so unfavorable as to make it doubtful whether any treatment is of avail, it is still our duty to treat it intelligently and carefully, the more so in view of the existence of such a doubt. Absolute rest should be secured to the patient, and any disturbance of the cerebral or peripheral nerves must be avoided. In dealing with a fatal disease the most minute details should be attended to; clockwork regularity should be observed in administering the medicines; the room should be darkened; and a tactful and careful attendant should have charge of the case. The iodide of potassium, quinine, opium, and the bromides should be the medicines administered. The bromide of potassium and the bromide of sodium are the best of the bromides, and, excepting that in some cases the sodium salt will better agree with the stomach, there is really no choice between them. The chosen bromide should be given in doses varying with the amount of convulsive disturbance and the age of the patient. A sufficient dose for children is usually 5 to 10 grains three or four times a day. The physician should increase these doses according to his judgment in cases of

convulsions. Of the iodide of potassium the minimum dose should be 5 grains three times a day, increasing as the exigencies of the case and age of the patient require. It should be given in a glass of water or Vichy, especially when the stomach is irritable. The tannate of quinine should be given to children three or four times a day. The best method of administering the tannate is in chocolates, which most manufacturing chemists are now making; a capsule or tablet triturate may be employed for the sulphate: and when this salt is used, it should never be given in solution with an acid. Although considerable difference of opinion exists as to the efficacy of quinine in any case of meningitis, I am yet firmly convinced that the administration of this drug sustains the strength of the patient. Opium is of great value as a calming agent when the cerebrum is very excitable. In children 5 drops of laudanum should be given from one to three times a day, according to the judgment of the physician. Moderately cold applications seem to afford great relief to some patients, whilst others are irritated by them, and this response to their use should be the guide; but the application of ice-bags or ice-cold compresses upon the patient's head is not advisable; for the purpose of contracting the arterioles may be attained by fairly cold applications, whilst the temperature may be dangerously lowered by ice, and the general strength decreased thereby. The subnitrate of bismuth, 5 to 10 grains, with $\frac{1}{6}$ to $\frac{1}{3}$ grain of codeine, will be found efficacious in cases of persistent vomiting; or pills of ice may be given, or a mustard plaster applied over the epigastrium from time to time. If cardiac weakness be manifested, it should be met by cardiac stimulants, such as camphor, digitalis, and strophanthus. Great care should be bestowed upon the food, which should be suited to the age of the patient, and consist only of the blandest and most nourishing kinds. If persistent vomiting exists to such an extent as to interfere with alimentation, resort should be had to nutritious injections.

II. Hydrocephalus.

This condition is known also as water on the brain and dropsy of the brain.

Etiology.—Hydrocephalus may be caused either by organic disease of the cerebrum or by meningitis, although it often occurs without any preceding disease, being then called primary hydrocephalus. In the so-called compensatory form of hydrocephalus, occurring with organic brain disease, the cerebro-spinal fluid flows to fill the intracranial vacuum caused by the loss of substance.

Symptoms.—The distinguishing symptom is an expansion of the skull in a peculiar shape, being flat behind and rounded in front, the orbital plates being obliquely directed and the eyes bulging downward and outward, and partially covered by the eyelids.

The mental defects are usually quite marked, and generally there are such physical symptoms as convulsions, contractures, and paralysis of one or more limbs. Amaurosis is occasionally seen, and the ophthalmoscope shows optic-nerve atrophy. In children there are usually symptoms resembling a mild meningitis—viz. disturbed sleep, restlessness, sharp cries, etc. These symptoms may be entirely lacking in cases occurring late in life, and the mental capacity may be excellent.

Prognosis.—The prognosis is very grave, as no cases of cure are known.

Diagnosis.—In marked cases, rickets and thickening of the cranial bones may sometimes be mistaken for hydrocephalus. But in rickets the form of the the head is somewhat square, with no bulging of the fontanelles; and in thickening of the cranial bones, in the few cases I have seen, there was hypertrophy of the facial bones.

Treatment.—In hydrocephalus treatment avails but little. Sometimes temporary benefit may be obtained by puncturing the anterior fontanelle, or, this being closed, by trephining the skull and piercing the subarachnoid space; but this is a dangerous experiment and sometimes results fatally. The same objection applies to the injection of the tincture of iodine through the fontanelle or through a puncture, inasmuch as it only affords temporary relief and sometimes causes death. Temporary benefit is often derived by compression of the skull by diachylon plaster, which can do no harm if the compression be not allowed to become extreme. It is applied in a very simple method: The plaster should be brought over the head in strips from front to back, from side to side, and diagonally, in such a manner as to obtain the most effective compression. An elastic band may also be used for the same purpose. A much safer method than any of these, in my opinion, and one which cannot fail of as good temporary results, is that of craniectomy. This should be done by the removal of a piece of bone, three or four inches long and about an inch wide, on each side of the median line. The compression of the brain is effectively relieved by this means, and if there be any virtue in the removal of compression, this is certainly an excellent method, whilst if done with the modern antiseptic precautions the operation is a perfectly safe one; but it is highly improbable that it will have more than the effect of temporary relief.

ABSCESS OF THE BRAIN.

By FREDERICK PETERSON, M. D.,

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Abscess may form in any part of the brain, but is much more common in the cerebrum than in the cerebellum, and is extremely rare in the basal ganglia, pons, and medulla. The white substance is more apt to suffer than the gray. As a rule, there is a single collection of pus, but occasionally there are multiple abscesses.

Etiology.—Abscess is the result of a suppurative encephalitis, due generally to an infectious irritant. The septic material may be derived from many sources, mostly local, but some distant. Of the local causes of brain-abscess, in all cases, ear disease is the most frequent. Next follow, in their order, traumata of the skull and scalp, diseases of the nasal cavity, non-traumatic caries of the cranial bones, and, rarely, orbital disease and intra-cranial tumors. Metastatic abscesses of the brain from distant sources have been known to follow pulmonary gangrene, empyema, typhoid fever, ulcerative endocarditis, measles, scarlet fever, small-pox, and other general septic diseases. Males are more commonly affected than females. No age is exempt from the disorder, but it is exceedingly rare during the first year of life. In 223 cases collected by Gowers, 24 occurred under ten years of age and 72 under twenty years. In childhood traumatic abscess is rather more frequent than any other form. In some cases no cause of any kind can be discovered.

Pathology.—The close connection of structures about the head, such as the scalp, bones, ear, and nasal cavity, with the brain, by means of vascular and lymphatic channels, accounts for the conveyance of septic material from these parts to that viscus. The first stage of suppurative encephalitis is known as "red softening." There are inflammatory œdema and swelling, with lessening of the consistence of the affected part, and reddening from distention of the minute blood-vessels, together with extravasations of blood into the tissues. There is infiltration of leucocytes. At first there is no strict delimitation of the diseased area. The ganglion-cells, nerve-fibres, and neuroglia are secondarily affected and undergo necrotic degeneration. As the encephalitis progresses, the pus-corpuscles become more numerous, until a greenish-tinted abscess is produced. At first the cavity containing the collection of pus is irregular and not strictly demarcated from surrounding tissues by a capsule. If the process continues long enough, the capsule begins to form in the shape of a delicate pseudo-membrane, which gradually becomes thick and firm, and gives the abscess a more or less spheroidal form. Usually some two months are required for the formation of encapsulated abscess, but often a much longer time. The capsule may be completely closed, or there may be a fistulous connection with the surface of the brain, or communication by rupture with either the outer surface or the ventricles. Inflammatory and degenerative changes may be found immediately about the encapsuled abscess in the neighboring

tissues. These abscesses vary in size from a centimetre to several inches in diameter, though from one to two inches is the usual dimension. Multiple abscesses are generally very small, and are sometimes miliary. There is a disagreeable fetor in a considerable number of brain-abscesses. An abscess may remain for long periods of time, even for years, in a stationary condition, or, as is more frequently the case, it enlarges until death is produced by interference with brain functions or by its bursting into the lateral ventricles or upon the outer surface of the brain, when purulent ependymitis or meningitis is excited.

While blows and falls upon the head are common causes in children, sometimes these traumata leave no traces, and the abscess resulting subsequently may not be considered due to so trifling a source. Even when injuries are visible in the scalp, there may be no hurt of bone apparent, and the abscess may lie deep in the brain. Usually, however, there is actual fracture or necrosis of bone, and the abscess is likely to be superficial and connected with the point of injury, though, even then, it may be isolated deep in the brain. The following case, observed by me in 1884 in a boy of twenty, is an illustration: In a street-row he was struck with a small heavy snuff-box on the forehead a little to the left of the middle line, causing a scalp wound and a small circumscribed depressed fracture of both tables. These pieces of bone were removed. The dura was normal. The parts were antiseptically treated. On the third day the temperature rose to 100° F. The wound looked well. On the thirteenth day he began to grow stupid, and three days later he died in coma. The autopsy showed the wound quite healed. The skull was exceedingly thin. The opening in the bone was $\frac{3}{4}$ by $\frac{1}{3}$ of an inch and contained a trifling amount of pus. The dura mater was perfectly normal, as were also the pia and arachnoid. There was evidence of brain-pressure, but no apparent injury to the superficies. In the white matter of the left frontal lobe an abscess the size of a small hen's egg was found which had no connection whatever with the exterior of the brain. The ventricles and all other parts of the brain were normal.

Sometimes a month or even a year or two may pass without the manifestation of cerebral symptoms. This may be explained by supposing that at first a very small abscess is formed, and that it remains quiescent for a long period before development.

The ear disease giving rise to abscess is usually a chronic disorder that may have existed for years, even as long as twenty-five years, before there is an extension of the trouble and the septic material is conveyed to the brain. The abscess generally forms in the temporo-sphenoidal lobe of the cerebrum or in the cerebellum. Here, too, the common seat of the affection is in the interior of the brain, separated from the point of origin by normal brain-tissues. In some cases it is more or less superficial.

Symptoms.—The symptoms are of two kinds—those which are especially due to the nature of the process, and those which are shared by abscess in common with other new formations, such as tumors, in the brain.

In the first category we have the symptoms of inflammation, more or less severe according to the acuteness or chronicity of the inflammatory change. There may be every grade of inflammation, from a severe, rapid, and quickly-fatal process to the slow, long-continued formation of an abscess, with remissions frequently amounting to complete quiescence and latency. Consequently, symptoms may be furibund or vague and indefinite. Changes of temperature, generally a rise of only one or two degrees, are noted; sometimes the temperature is subnormal. The pulse may at times be rapid, but is apt more commonly to be much reduced in frequency. There are anorexia, constipation,

general malaise, and chilly sensations amounting at times to rigors. Headache is as frequent as in tumor, and similar in its character. Quite frequently it indicates to a certain extent the position of the lesion, especially when the abscess is of traumatic origin. Sometimes there is vomiting. Convulsions are uncommon in the early, but frequent in the later stages. When general, they show the severity and extent of the abscess; when Jacksonian, they reveal its position in or beneath the motor cortical area. As the disease progresses delirium may appear, followed by stupor, gradually passing into coma. During the "latent" period—which is noted in many cases, and which may last for months or years—some of the above symptoms may be manifested in slight degree and with intermissions: but the latent period usually terminates abruptly with all of the indications of acute abscess. Vomiting and giddiness are very common in cerebellar abscess, but may also occur in cerebral forms. Paralysis is present in nearly one-half of the cases. The cranial nerves may be affected. Mental symptoms are more difficult to study in the child than in the adult.

Optic neuritis is often, but not always, present in cerebral abscess. It is inclined to be milder than in the cases of tumor, and more apt to be unilateral. It is very rarely observed in cerebellar abscess. Altogether, choked disk is not so frequently met with in abscess as in tumor.

Focal symptoms are not so common as in tumor, because abscess is more often situated in parts like the temporo-sphenoidal and frontal lobes, where lesions are less apt to give definite objective symptoms, and because the pressure of abscess is often less pronounced and more gradually developed than is the case in tumor.

Rupture of the abscess usually produces sudden evidences of acute purulent meningitis or symptoms resembling those of ventricular hæmorrhage.

Prognosis.—The outlook in all these cases is exceedingly grave. Acute abscess may run its course to a fatal termination in from one week to a month. Chronic abscess with a period of latency runs a very uncertain course, sometimes terminating suddenly, sometimes slowly developing acute symptoms. Even where abscess remains latent for years (in one case twenty years), death is apt to follow from some unexpected renewal of its activity. This may occur even after calcification of its capsule and inspissation of its contents.

Diagnosis.—Usually a diagnosis may be made from the history of an onset after ear or nasal disease or traumatism of the head, and from the symptoms characteristic of a suppurative encephalitis and of a foreign body in the brain. In acute abscess it is necessary to distinguish between it and meningitis, though this is often extremely difficult where the meningitis is of the suppurative form. The two may coexist, and both are often due to the same causes. The stiffness of the neck, tendency to opisthotonos and convulsions, and the more frequent implication of the cranial nerves in meningitis must be our guide. In the chronic form of abscess the distinction from tumor is often difficult; but here, too, the matter of cause is of great importance, though injury may indeed give origin to either. Definitely localizing symptoms, gradually extending and tending to involve the cranial nerves, together with more marked optic neuritis, and the greater frequency of tumor than abscess, are strong indications in favor of the former.

Treatment.—Surgical procedures are advisable in almost all cases, as abscess is almost certainly fatal, even in cases where latency may last for years. Trephining and the removal of pus, either by free opening and drainage or by the aspirating needle where deeply-seated, have been successful in a number of instances, especially in those following injury to the cranial bones and in

ear disease. As prophylactic measures, local bone disease from trauma or aural inflammations should be most thoroughly and conscientiously treated. The mastoid operation should be undertaken at the earliest appearance of a tendency to extension of the inflammatory process to the meninges and brain. Rest, the application of cold, the use of derivatives in the way of counter-irritants, and the improvement of general health by means of tonics and hygienic measures, have at times their importance in these cases, but too much reliance should not be placed upon these illusory measures.

TUMORS OF THE BRAIN AND MENINGES.

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Neoplasms within the cavity of the skull are quite as frequent in childhood and youth as in adult life, and are to be met with even in earliest infancy. They occur in any part of the brain, either as metastatic growths from tumors elsewhere, or as primary developments from the neuroglia, vascular channels, membranes, or cranial bones. Sometimes a scalp neoplasm may erode the bones and affect the substance of the brain, as in a case reported by Braun, where a girl of fourteen had a carcinoma of the scalp which partially destroyed some of the cerebral cortex after eroding the bone.

Etiology.—Males are much more frequently affected by tumors than females, the proportion as given by M. Allen Starr being two to one. Up to the age of twenty years cerebral neoplasms are commoner before the age of eight years than after it. There are a few cases in which the cause may be ascribed to blows or falls upon the skull, yet the traumatic factor is probably not so great as is generally believed. Heredity, fright, mental strain, and the like seem to have little to do with their origin. Primary tumors of the brain are not as frequent as secondary growths, and tubercles, sarcomata, and carcinomata are especially, almost always, secondary to neoplasms in other parts of the body.

Pathology.—In Keating's Cyclopædia, M. Allen Starr has collected 300 cases of tumors of the brain in children from current medical journals and including the collections of Bernhardt and Steffan, thus bringing his list up to the beginning of the year 1888. To these I have added some 35 others, obtained from current literature since that date. Upon these cases and those collected by Starr and upon Knapp's monograph (*Intracranial Growths*, Boston, 1891) this study is mainly based.

The comparative frequency of the various kinds of tumor in children may be seen from the following table:

Form of Tumor.	No. of Cases.
Tubercle	166
Glioma	42
Sarcoma	37
Cyst	35
Carcinoma	11
Glio-sarcoma	5
Angio-sarcoma	1
Myxo-sarcoma	1
Papillary epithelioma	1
Gumma	1
Not stated	35
Total	335

It will thus be seen that tubercular tumors are by far the most common in

children, occurring four times as frequently as gliomata and five times as frequently as sarcomata. Another feature of great interest is the rather common development of more than one neoplasm in the same brain. This is particularly noteworthy in the case of tubercle, 43 of the above-mentioned 166 cases having presented multiple tumors. Thus in a case described by West, a boy aged fourteen had twelve tubercular tumors in the brain, although there were symptoms of but one. Moreover, sarcomata and cysts are occasionally multiple, 4 of the 37 cases of sarcomata and 4 of the 35 cases of cysts having been found to be multiple.

Tubercular Tumors.—Though occasionally primary in the brain, these tumors are usually due to secondary infection from tubercular processes elsewhere, in glands, lungs, or bones. Infection may be carried to the membrane from a tubercular tumor in the brain, thus giving rise to a secondary tubercular meningitis. About a fourth of the cases have multiple brain-tumors, the neoplasms varying from the size of a millet-seed to that of an egg. Usually round or nodular and encapsulated, they are at times very irregular and diffuse without marked delimitation. They nearly always arise from the membranes of the brain, chiefly the pia or its prolongations, though occasionally they are to be found in the interior, and not connected with the meninges. They owe their existence to the entrance of tubercle bacilli by way of the blood-vessels or lymphatics. Like gumma, the tubercular tumor is a form of granuloma, and histologically they are very much alike, the periphery being composed of the round-cells of granulation tissue, giant-cells, and often epithelioid cells, while the centre is caseous. A few tubercle bacilli may be found in the outer parts, and in the tubercle the caseous mass is confluent, while in the gumma there are apt to be several separate caseous masses. Characteristic vascular changes, such as endarteritis obliterans and periarteritis, often aid in the differentiation of the syphiloma. The extreme rarity of gumma in children, as seen in the above table, must be borne in mind. In fact, this one case of gumma was in a youth of eighteen.

Gliomata.—These tumors come next after tubercle in point of frequency. They are due to a hyperplasia of the peculiar connective tissue of the nervous system, the glia or neuroglia. As is well known, this connective substance is allied in some respects to mucous tissue. The glioma resembles neuroglia in its histological characters, but the cells are more numerous and vary much in size. This tumor is a peculiarly nervous one, growing especially in the central nervous system, though sometimes developing in the eye from the retina. Some gliomata are hard, from the greater proliferation of fibrous tissue, but the majority are rather soft and cellular, and are prone to undergo secondary changes, such as fatty degeneration and caseation. Often they are rich in delicate blood-vessels which by rupture give rise to hæmorrhages. Such hæmorrhages may terminate a case, as in ordinary apoplexy, or the clot may become caseous or form a cyst. The glioma being essentially a tumor of nervous connective tissue, it is found generally in the interior of the nervous organs, almost never connected with the membranes. It grows slowly, and is not malignant, though it has a tendency to return after removal. It is always solitary. When hard, it is usually easy to distinguish it from surrounding brain-tissue; when soft, its limits are not always readily defined. The development of mucous tissue in the tumor leads to the designation of myxo-glioma, and of numerous round and spindle-shaped cells to that of glio-sarcoma. Glioma varies much in size, but may attain greater proportions than any other tumor.

Sarcomata.—In children sarcoma is not quite as frequent as glioma. It is a rapidly-growing tumor, developing anywhere in the brain or from its mem-

branes. Usually solitary, it may in rare instances be multiple. It is generally primary, but may be metastatic from sarcoma elsewhere. It may be of any size, but as a rule it is rounded or nodular in shape, and well differentiated from the normal tissues. When fibrous tissue is present in unusual proportion, the tumor is hard; when the cellular elements (round, spindle-shaped, giant, and stellate cells) are more abundant, it is soft. The interior may undergo secondary changes, such as caseation, fatty degeneration, hæmorrhage, and the formation of cysts. The proliferation of particular histological elements gives rise to such designations as myxo-, glio-, fibro-, lympho-, cysto-, angio-, melano-, round-celled, spindle-celled, and endothelial sarcoma. This neoplasm is malignant.

Cysts.—Cysts may result from secondary changes in old hæmorrhages, and such are frequently found in the brains of children suffering from infantile cerebral palsies and organic idiocy. Newly-formed cysts are generally, however, due to echinococcus or cysticercus cellulosæ. These are more common in Europe and Australia, apparently, than in America. The cyst of the former (hydatid) is usually single, but may reach a large size. The cysticercus is commonly small, producing few symptoms, and frequently multiple. The cysts may grow anywhere in the brain, but their development is very slow. Both may be recognized by the peculiar cystic character or by the examination of their hooklets, those of the cysticercus being very much larger than those of the hydatid.

Carcinomata.—About one-thirtieth of the brain-tumors in children are carcinomata, and are always secondary to growths developed elsewhere, or extend directly from the scalp, bones, or orbital tissues.

Miscellaneous.—Gumma is apparently so rare in early youth that it may be said not to exist. I have not been able to find in literature any case except the one given in the table, occurring at the age of eighteen years. Aneurism, psammoma, lipoma, papilloma, myxoma, fibroma, osteoma, neuroma, adenoma, cholesteatoma, teratoma, and enchondroma are among the greatest rarities.

Symptoms.—In very young children the head may be enlarged, either generally, as in hydrocephalus, or there may be actual protrusion of certain limited portions of the skull, as in a case I saw some years ago of extreme oxycephalus. The neoplasms at times erode the cranial bones and bulge out beneath the scalp. Displacement of the eyeball has been noted in cases where the tumor has extended into the orbit.

But in most cases there is no outward indication of the presence of an intracranial growth, and we must diagnosticate its presence by certain general manifestations, such as headache, vertigo, vomiting, sleeplessness, visual disorders, mental changes, spasms, fever, and the like, and by localizing symptoms, as paralysis, limited spasm, anæsthesia, disordered locomotion, and disturbances in the functions of cranial nerves. Some or all of the general symptoms may be present in almost every case of intracranial tumor, no matter what may be its situation, but the exact seat of the neoplasm must be determined by a careful study of the motor, sensory, reflex, and psychic symptoms, and based upon an accurate knowledge of the physiological anatomy of the brain. In rare instances tumor of the brain may exist, giving rise to scarcely any symptoms at all.

Headache.—This is found in the majority of cases of brain-tumor, according to Mary Putnam Jacobi in about two-thirds of the cases. It is more frequent and more severe in cerebellar growths hemmed in beneath the tense tentorium. The pain is doubtless chiefly due to pressure upon, or irritation of, the sensitive dura mater. It may be in any part of the head, but is usually

frontal or occipital, without reference to the seat of the tumor. Occasionally the pain is distinctly and constantly localized at one place, and here there may be tenderness of the scalp and head on percussion, this being under such circumstances of value as a localizing symptom. The pain is dull and continuous or intermittent and severe. Infants probably suffer less, owing to the greater distensibility of the skull; and in them pain may be inferred from restlessness, irritability, sharp cries, sleeplessness, and burrowing movements of the head.

Nausea and Vomiting.—These symptoms are noted in from one-fifth to one-fourth of the cases. They are commoner in children than in adults. The vomiting may occur without nausea, irrespective of the taking of food, and intermittently or more or less continuously. It may be associated with vertigo, and frequently accompanies severe headache. It is often brought on by movement of the body. It is most common in cerebellar tumor.

Vertigo.—This symptom is not uncommon, and is particularly frequent with cerebellar neoplasms. As it accompanies so many divers affections outside of the cranial cavity, it cannot be regarded as of great diagnostic value.

Optic Neuritis.—The optic nerves are affected, according to Starr, in 80 per cent. of cases of brain-tumor, and hence this constitutes one of the most significant objective symptoms. It must be always looked for, since neuritis may exist to a very great extent without visual defect. Usually double, it may at first appear in one eye, and generally one disk is more affected than the other. This symptom, too, is more common in tumors of the cerebellum and at the base of the brain. It must be remembered, however, that it occurs in other disorders beside brain-tumor, such as meningitis, hydrocephalus, and abscess. Optic atrophy may follow the neuritis.

Convulsions.—Spasms are of frequent occurrence in the brain-tumors of childhood. They may be slight (*petit mal*) or severe, limited to certain members, or general, infrequent or frequent—twenty to thirty per day. General convulsions have no significance as to the seat of the lesion, nor can partial epilepsy (Jacksonian) always be relied upon to indicate the situation of the tumor.

Mental Changes.—In at least half of the cases some psychical disturbance is manifest. This is naturally much varied according to the amount of brain injury and the age of the child. It may show itself in mere fretfulness and irritability, or there may be dulness, lethargy, hebetude. In some cases there may be delirium, maniacal excitement, or an enfeeblement of the mental processes amounting to dementia. Somnolence is a common symptom in children. As the disease progresses this often deepens into coma.

Tremor, *insomnia*, *fever*, *neuralgia*, *slow* or *rapid pulse*, *disturbances of respiration*, and *constipation*, are symptoms occasionally observed in certain cases, but from these no significant deductions can be made. Increase of *head-temperature*, local or general, as measured by the surface thermometer, has not yet been sufficiently studied to be practically available as a symptom in brain-tumor.

Localizing Symptoms.—After due and careful consideration of these *general* symptoms, we must examine the *focal* manifestations, which are either irritative or destructive. Localizing symptoms depend altogether upon the seat of the tumor, whether adjacent to the motor area of the cortex (partial epilepsy) or in the motor tract (monoplegia or hemiplegia); in the sensory areas or tracts (anæsthesia, hemianæsthesia, hemianopsia, etc.); in motor or sensory speech-centres or tracts (aphasia in various forms); or, finally, impinging upon cranial nerve nuclei or trunks (paralysis of cranial nerves).

Gradual onset and *spread* are the rule in brain-tumor. There are occasional exceptions, since a secondary meningitis or a hæmorrhage in the new growth may produce a sudden exacerbation; and there are in rare instances intermissions, remissions, or even retrogressions, in the course of its development.

Usually the symptoms of cerebral or cerebellar tumor are *unilateral*, whereas those of neoplasm at the base affecting the cerebral axis are often *bilateral.*

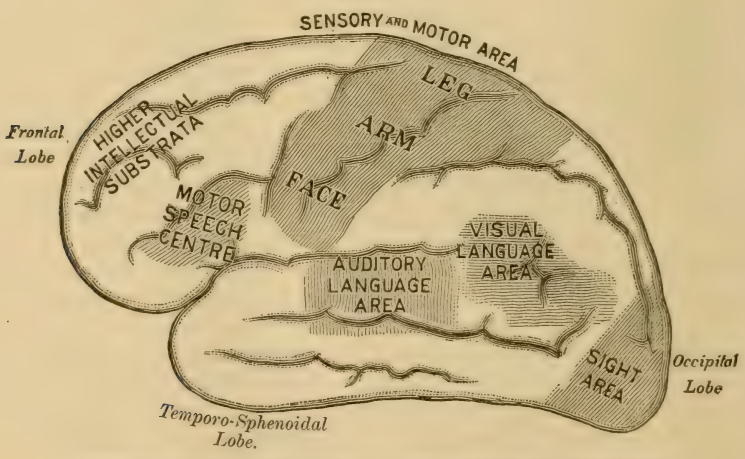
The relative frequency with which tumors affect the various parts of the brain may be learned from the following table:

Site of Tumor.	Number of Cases.
Cerebellum	105
Pons Varolii	42
Centrum ovale	41
Basal ganglia and lateral ventricles	30
Corpora quadrigemina and crura cerebri	25
Cortex cerebri	23
Medulla oblongata	7
Fourth ventricle	6
Base of brain	8
Total	287

From this it will be seen that tumors of the cerebellum are slightly in excess of those of the cerebrum proper (105 to 94), while the remaining 88 cases were of new growths in the structures about the base of the brain (crura, pons, and medulla).

Tumors of Cortical and Subcortical Regions.—These are mostly tubercles, sarcomata, gliomata, and cysts. It is difficult to differentiate cortical from subcortical tumors, the symptoms being about the same, and neoplasms in either portion tending by extension to involve the other. The manifestations will vary according to the functions of cortical centres or descending tracts involved. A study of Figs. 1 and 2 will show what functions will be destroyed by tumors affecting the different portions of cortex there represented, while in Fig. 3 the tracts of fibres which convey impulses to and from these various centres are shown. The chief points to be noted in relation to new growths here may be briefly stated as follows:

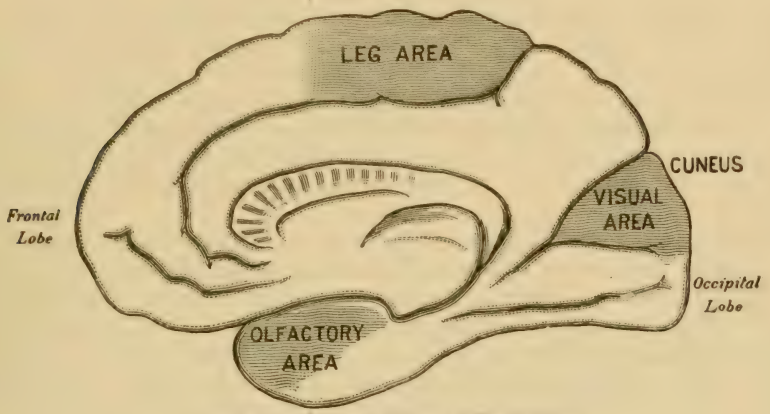
Fig. 1.



Scheme of Localization in Cortex of Convex Surface of Hemisphere.

Tumors of the Frontal Lobe often present no marked symptoms. If they impinge downward upon the olfactory bulb, they may give rise to loss of the sense of smell. There are often mental changes, such as difficulty in concen-

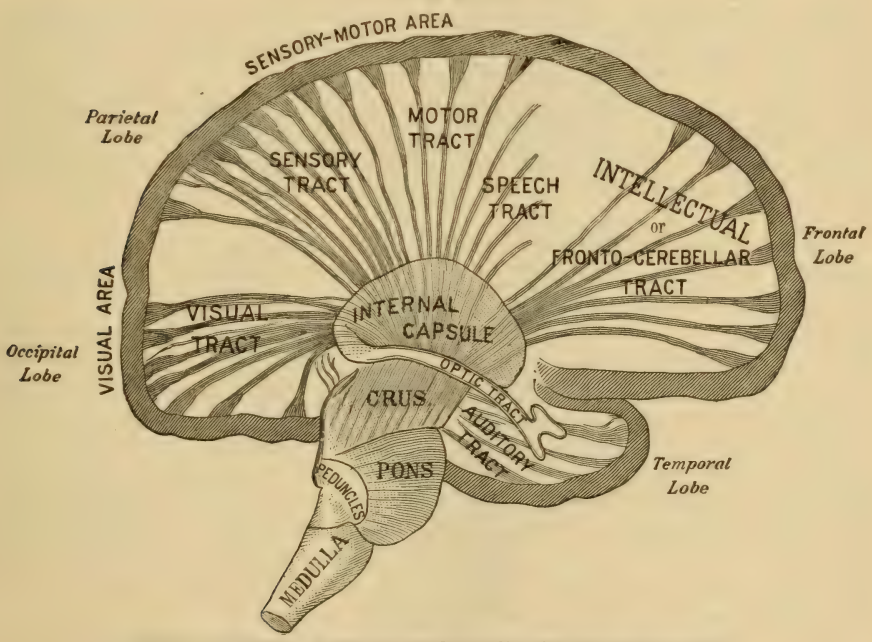
FIG. 2.



Localization on Inner Surface of Hemisphere.

trating attention, of thinking connectedly, of exercising self-control, of comprehending with ease, or of acquiring and retaining new knowledge. Sometimes there is great mental torpor and enfeeblement amounting to imbecility.

FIG. 3.



Scheme of Position of Fibre-tracts descending from the various areas.

But irritation from the frontal cortex may extend backward to the motor areas, and thus produce hemi-epilepsy or general convulsions. If the tumor exerts much pressure backward or extends into the motor area or tracts, paresis or

paralysis of the opposite side of the body, beginning often as a monoplegia, is developed.

Tumors Affecting the Third Frontal Convolution of the left hemisphere in right-handed persons give rise to motor aphasia, and occasionally agraphia, of imperfect type. In a slowly-growing lesion, like tumor, the opposite hemisphere may often gradually compensate for the loss of function in the affected side. This matter of aphasia, however, is not so important a localizing symptom in children as in adults. From studies I have made of hemiplegia in children I have been led to conclude that during the first years of life (perhaps up to eight or ten years or more) the two hemispheres share equally the motor and sensory functions of speech, and that it is only during adolescence that the left hemisphere (in right-handed persons) takes upon itself gradually the greatest part of this burden.

Tumors about the Fissure of Rolando, or Motor Area, cause convulsions or paralysis of the side opposite to the lesion, affecting later the face, arm, or leg, or all together, according to the size and exact position of the growth. These local spasms are known as partial or Jacksonian epilepsy. When the spasm precedes paralysis, the probability is that the cortex is first affected. When the paralysis precedes the onset of spasm, we may reasonably conclude that the neoplasm began to develop in the white matter beneath the cortex. There may be some anæsthesia in connection with the paresis, for it is generally believed that the motor area subserves sensation also to a great extent. In all of these cases it is important to study the character and manner of onset of the spasms, whether partial or general. The aura of the epileptic attack is often of great value in determining the exact seat of the lesion. This aura may be a sensation of numbness or tingling, arising, for instance, in the fingers, hands, or toes. Seguin has given to this phenomenon the name "signal symptom." It indicates the starting-point of the cortical excitation. The order of extension of the spasm after the signal symptom must also be noted, for it indicates the path of extension of the discharge along the cortex. In the paralyzed parts the deep reflexes are of course exaggerated, as in all forms of cerebral palsy, and there is no actual atrophy, though disuse often leads to a diminution in the size of the affected members.

Tumors of the Parietal Lobe, like those of the frontal, often give no localizing symptoms, though the studies of M. Allen Starr and Dana are quite conclusive as to the frequency of sensory disturbances (muscular, tactile, pain, and temperature sense) in lesions at this point. Thus at times paræsthesia and anæsthesia may be found in the opposite limbs. But irritation may extend from the parietal area forward to the motor, and thus produce, as in the case of frontal neoplasms, partial or general convulsions. And by progressive extension the tumor may invade neighboring structures, and thus give rise to focal manifestations (motor symptoms by forward extension, hemianopsia by downward extension to the visual tract). In adults tumor in the inferior parietal lobule of the left side produces word-blindness, but this indication is of doubtful value in children. We do not yet possess sufficient information on this point to make any definite statements. The same is applicable to the matter of affections of the auditory speech-centre indicated in Fig. 1.

Tumors of the Occipital Lobe, in addition to general symptoms, give rise to the very important one of blindness of a half of each eye opposite to the the lesion (homonymous hemianopsia). The blindness is opposite to the lesion, but of course the affected half of the retina of each eye is on the same side as the lesion. From the occipital cortex, also, discharges may extend forward to

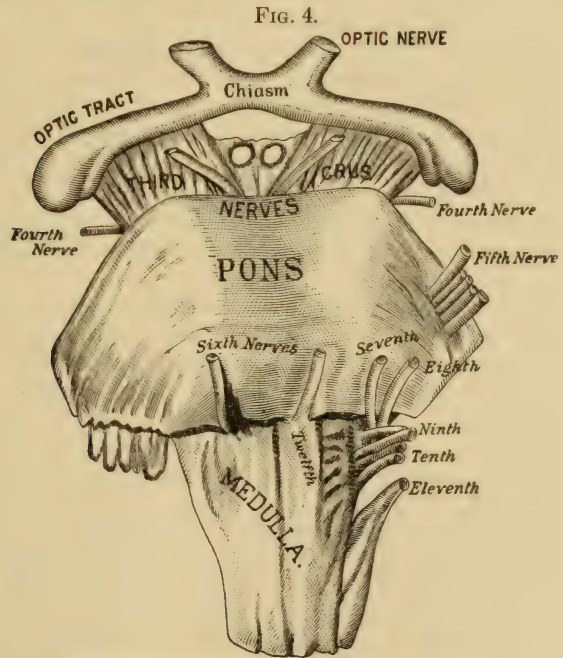
the motor area and produce convulsions, as in a case now under the care of Starr and myself, where a lesion (hæmorrhage at birth) in a girl of fifteen has given rise to hemianopsia and genuine epilepsy. A tumor by continued growth may affect parts forward, such as the sensory tract (hemianæsthesia) and even the motor (hemiplegia).

Tumors of the Temporo-sphenoidal Lobe will be apt, especially in children, to cause no definite localizing symptoms. The sense of hearing has its centre in the first and second temporal convolutions, and smell and taste have been assigned to the tip of this lobe. In adults it is probable that the form of sensory aphasia known as word-deafness may be produced by lesion in one part of the left temporo-sphenoidal lobe. We have still much to learn in this connection in the pathology of childhood.

Tumors of the Basal Ganglia, Lateral Ventricles and Island of Reil, by their encroachment upon the internal capsule, through which so many important tracts pass (see Fig. 3), are prone to give rise to marked and widespread symptoms, such as hemiplegia (when anterior part of capsule is affected) and hemianæsthesia and hemianopsia (when the posterior part of the capsule is involved). Other than these no definite localizing symptoms will be noted in children. At times other structures (such as the cranial nerves) may be affected by pressure or distortion by tumors in these regions.

Tumors about the Crura Cerebri give rise to a variety of symptoms according to the parts affected and the extent of the lesion. The crus contains the motor and sensory tracts, and the two third nerves (motor oculi) rise from the crura very close together (Fig. 4). Thus if one crus is involved, there will

Fig. 4.



Structures at Base of Brain, to show topography.

be complete hemiplegia of the opposite side (occasionally hemianæsthesia also), and third-nerve paralysis on the same side (ptosis, etc.). This is called alternate or crossed hemiplegia. The optic tract is near at hand also, and if

affected, which is seldom, will give rise to homonymous hemianopsia (probably with hemiopic pupillary inaction). There may be unilateral incoördination. If the tumor be interpeduncular, some of the symptoms here mentioned will be bilateral. Optic neuritis is apt to develop early in these cases.

Tumors of the Quadrigeminal Region are among the rarities. Some fibres of the optic nerve enter the corpora quadrigemina, and the centre for the reflex to light lies in them. Contiguous to them lie the nuclei of all of the motor nerves of the two eyes (third and fourth and fibres of sixth). Nothnagel has made a study of tumors of this region based upon 10 cases collected by Bernhardt and 4 cases of his own, so that the symptomatology is pretty well established. There is staggering gait, resembling cerebellar titubation, and a progressive double ophthalmoplegia. The ataxia may be the earliest symptom. When this is followed by the condition of immovable bulbi, we may be quite sure of our diagnosis. The ocular paralyses may be unequal on the two sides. Nystagmus has been observed in but one case. As the tumor develops, hydrocephalus is produced by pressure upon the aqueduct of Sylvius. A hemiparesis and hemianæsthesia, or irregular paralytic and anæsthetic symptoms, may be produced by extension of the growths toward the crus on either or both sides. The optic neuritis and blindness observed are due to the same causes at work in conjunction with neoplasms elsewhere. Three years ago I observed a case of quadrigeminal tumor in a little girl at the New York Polyclinic. Her first symptom was staggering gait. Then there was gradual development of oculomotor paralysis and blindness, and finally slight hemiparesis. At the autopsy I found a tubercle the size of a hazel-nut in the quadrigeminal region. There was also tubercular meningitis, and a few small tubercles in the cerebellum. The case has been reported by Sachs.

Tumors of the Pons Varolii give generally distinctive localizing symptoms, because of the cranial nerves which arise from or are adjacent to it. Thus the third nerve rises from the crus close to its upper border, the fifth from its lateral aspect; the sixth lies upon it; the seventh and eighth have their superficial origin below its lower border. In the interior of the pons are the motor and sensory tracts for both sides of the body, and the nuclei of several nerves (fifth, sixth, and seventh). If unilateral, the tumor is apt to give rise to crossed paralyses or alternating hemiplegia and alternating anæsthesia. In the upper half of the pons a tumor involving part of the crus may cause ptosis and external strabismus, and anæsthesia upon one side, hemiplegia upon the other. In the lower part the growth may produce internal strabismus (sixth nerve), facial paralysis, and deafness, associated, possibly, with paralysis of the arm and leg of the opposite side. If the tumor affects the *root* or *trunk* of the sixth nerve, as may be the case in neoplasms growing from the base of the skull, the loss of power is only in the muscle supplied by that nerve. But if the *nucleus* of the sixth nerve be involved, there is a peculiar disorder of *both* eyes; that is, a loss of power in the internal rectus of the opposite eye also, which is only shown in the impossibility of conjugate movement of the two eyes toward the side of the lesion, since the external rectus of one eye and the internal rectus of the other habitually act together. There is in such lesions a conjugate deviation of both eyes to the side opposite to the lesion.

A lesion may be so placed in the pons that none of the cranial nerves are involved, and only a hemiplegia is produced, indistinguishable from a capsular hemiplegia. If both motor paths are involved, we may have a paraplegia. Such a lesion is generally accompanied by cranial nerve involvement on one or possibly both sides.

Both sensory and motor paths may be involved in primitive lesions, but

these paths are rather widely separated by the deep transverse fibres of the pons, and in such cases the lesion must be large.

Tumors affecting the Medulla Oblongata are prone to give rise to striking symptoms, such as dysphagia, disturbances of the respiration and pulse, severe vomiting, polyuria, glycosuria, etc., from involvement of important nerves (glosso-pharyngeal, pneumogastric, hypoglossal, and spinal accessory), and widespread paralyses and anæsthesias from their impinging upon the great motor and sensory tracts contained in the medulla. These symptoms are generally bilateral.

In growths affecting either pons or medulla all sorts of combinations of symptoms may be observed, too numerous to be described here. The general symptoms, such as headache, vertigo, and vomiting, are common, but convulsions are rare.

Tumors of the Cerebellum are among the most common of the intracranial growths in children. In the middle lobe they produce cerebellar titubation, a staggering gait much resembling that of a drunken man. Vertigo is also an important symptom, and is more severe and continuous than that caused by growths elsewhere. If the middle peduncle of either side be involved, the staggering is more to one side than the other. Tumors of the hemispheres of the cerebellum give rise to no focal symptoms unless they impinge upon the middle lobe or the peduncles. Cerebellar neoplasms by extension are apt to injure cranial nerves about the pons or medulla. Hydrocephalus is often observed: it is due to pressure upon the fourth ventricle or veins of Galen.

Tumors at the Base of the Brain in the anterior, middle, or posterior fossæ are diagnosticated by the symptoms characteristic of pressure upon or destruction of the important structures already mentioned.

Differential Diagnosis.—The presence, site, and nature of a neoplasm must be determined by the facts given in the preceding pages. Brain-abscess is differentiated by its own peculiar symptoms, described in another part of this volume. Tubercular meningitis sometimes presents symptoms similar to those of intracranial neoplasms, particularly when chronic. Ordinary forms are easily distinguished. Chronic hydrocephalus and cerebral hæmorrhage, when unusual in character, may simulate tumor, but careful study of the mode and order of development of their manifestations will generally serve to distinguish them.

Prognosis.—The prognosis is death unless the tumor be removed. M. Allen Starr gives the average duration of life as two years. Death occurs ordinarily by gradually increasing coma, sometimes with convulsions. Occasionally hæmorrhage in or about the tumor (especially in gliomata) may terminate life. At times a sudden meningitis (in tubercular forms) brings about a fatal end. Sudden death from unknown cause may occur.

Treatment.—It is evident that medicinal treatment of intracranial tumor must be in most cases merely palliative. Gumma of the brain being a growth almost never met with in children, the question of antisyphilitic treatment need not be discussed here. While it is always wise to make use of antitubercular treatment in cases suspected to be of this nature, it is doubtful if much can be done to diminish the extent or stop the progress of such neoplasms.

The routine treatment with cod-liver oil, tonics, fresh air, and the like, should certainly be carried out. It is possible that tuberculin or tuberculocidin may after a time be made available for such cases, but as yet the subject is too new to form any pronounced opinion. Klebs's experience with tuberculocidin in tubercular disease of the lungs, skin, bones, and joints is promising.

It is usual in most cases of brain-tumor, of whatever nature, to employ iodide of potassium in 10- to 20-grain doses, three times daily after eating, in an abundance of menstruum (water or milk). Arsenic is occasionally as useful.

In all cases there are symptoms requiring treatment, such as headache, intracranial pressure, insomnia, and convulsions. Antipyrin (2 to 10 grains according to age), cannabis Indica ($\frac{1}{2}$ to 3 minims of the fluid extract), and morphine ($\frac{1}{50}$ to $\frac{1}{12}$ of a grain) are good agents in headache due to this cause. Intracranial pressure may be relieved to some extent by purges, prolonged warm baths, the hot wet pack, and wet leg compresses. These remedies may quiet headache, vertigo, and vomiting, and will relieve insomnia. The bromides are often useful for insomnia, pain, restlessness, and vomiting, and are always indicated, combined with chloral, in cases with a tendency to convulsions.

The question of surgical interference will arise, for in this lies the only hope of effective relief against impending death. The question of the uses and value of cerebral surgery in children is still under consideration. Operations on the brain in children are more dangerous than in adults. The mortality is very great. There is a greater difficulty in diagnosis and localization in children. There is a larger percentage of cases of multiple tumors in childhood. Some 25 per cent. of the tubercular tumors of childhood are multiple. Considerably more than half of the neoplasms of the brain in childhood are situated in structures in the posterior fossa of the skull, and this region deserves the name of the surgical *noli-me-tangere* much more in children than in adults. Infiltrating tumors, of no well-defined limitation, are not uncommon. Thus we are forced to the conclusion that we must be much more conservative in advising surgical procedures in the brain-tumors of children than we need be in those of adults. When we have pretty certain evidence of the presence of a solitary new-growth in the cortex or centrum ovale of the cerebrum, we may attempt removal with a fair hope of accomplishing a good result. The large percentage of tumors with a recedivial tendency must, however, not be forgotten. The whole matter of brain surgery as regards children is still in an experimental stage.

THE AFFECTIONS OF THE NERVOUS SYSTEM DUE TO INHERITED SYPHILIS.

By CHARLES W. BURR, M. D.,

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It has long been known that inherited syphilis may lead to disorders of the nervous system, but the matter was little studied until recent years. Many cases have been reported, and a review of the literature shows that as in the acquired disease any part of the nervous system, central or peripheral, may be affected. It is noteworthy, however, that in children born alive the nervous system is much less frequently the seat of disease than are the other organs. The exact percentage cannot for obvious reasons be determined. We have no positive data concerning the proportion of stillborn or aborted syphilitic infants with lesions of the nervous system. Much remains to be learned of the pathology of the disease, and the present paper will be confined, in large measure, to its clinical aspect.

Fournier claims that *persistent headache* with *nocturnal exacerbations* is one of the most frequent symptoms. Accompanying it, indeed often its only evidence, are extreme irritability, sleeplessness, and spells of screaming. Demme records a case in which the following cycle recurred: headache followed by anger, then torpor, and finally diabetes insipidus. Convulsions are very common, and are probably one of the most frequent immediate causes of death. They are usually bilateral, and with tonic and clonic contractions. Laryngismus and tetany, though most apt to be due to rachitis, sometimes occur. Barlow and Bury record the case of a child who had ten to twelve fits daily from the fourteenth day to the seventh month. In another case which came to autopsy at the fourth month extensive meningeal changes were found; and in a third, there were no cortical changes in the convexity, but symmetrical gummata were present on several cranial nerves. In this last case there were convulsive seizures in which the mouth was widely opened and the child became very dusky.

A few cases of apparently idiopathic *epilepsy* have been recorded in which the only discoverable cause was inherited syphilis. Gowers cites eight, in six of which the fits began after infancy. Abner Post relates an interesting case in which the attacks began with vertigo, the patient feeling as if she were in a boat which was rocking violently. They lasted about half an hour, and were followed by nausea and vomiting. There was never unconsciousness. The attacks occurred as often as three times a week, and disappeared under the use of iodide of potassium. According to Fournier, the condition is apt to be accompanied by pain in the head, noises in the ears, dimness of vision, vertigo, and intellectual failure. In the greater number of cases there are added to the fits, sooner or later, other symptoms of cerebral or spinal mischief.

The differential diagnosis between tubercular meningitis and syphilis is

often impossible unless a history of hereditary taint or evidence of it can be found. According to Horatio C. Wood, a general indefiniteness of symptoms and slowness of progression should arouse suspicion, especially if the absence of the pulse retardation indicates that the vault rather than the base of the cranium is in fault. Stoeber gives the following points in diagnosis: Tubercular meningitis is rare under one year; there is seldom palsy at the beginning; pyrexia is present; and the pulse is slow. Syphilis, on the other hand, may occur soon after birth; palsy is often present from the first; frequently fever is absent, and the pulse is irregular. Stoeber further regards retraction of the abdomen, projectile vomiting, constipation, delirium, contractures, and rapid wasting as characteristic of the former disease. Too often, however, diagnosis can only be made when it is no longer needed. Recovery means syphilis, as it is more probable that an error in diagnosis has been made than that a tuberculous case has recovered.

Hemiplegia is infrequent. In Osler's series of 120 cases only 1 presented a pretty definite history of syphilis. On the other hand, in Abercrombie's series of 50 cases at least 4 were syphilitic. Barlow and Bury report an interesting case in which there was at first loss of speech with right-sided paresis. After about four months of mercurial treatment the patient recovered almost completely, only to be again attacked, this time by left paresis and loss of speech. Finally there was complete recovery. The authors believe that there was endoarteritis of symmetrical branches of the middle cerebral arteries and degeneration of the cortical centres, especially of the third frontal, on both sides. A case of left-sided hemiplegia in a girl ten years old, described by Hughlings-Jackson, is made doubly interesting by the fact that two years before she had had chorea confined to the same side. Marfan relates a case in a child four months old in which recovery followed two weeks' mercurial treatment. Ordinarily, one-sided fits precede the palsy, and quite often convulsions continue in the palsied members; but it may come on without convulsions—without, indeed, warning of any kind. The child simply falls unconscious, and returns to consciousness palsied. In rare cases even consciousness is not disturbed. On the other hand, there may be restlessness, vomiting, and headache. The presence or absence of aphasia depends of course upon the situation of the lesion.

The most common anatomical basis of cerebral syphilis is *endoarteritis* and thrombosis with sclerosis and meningeal thickening. Angel Money, however, showed a specimen to the Pathological Society of London in which there were atrophy and sclerosis of the left hemisphere without disease of the arteries or membranes. Gummata are very rare. Rumpf cites but two, and M. Allan Starr in a table of 299 brain tumors occurring in persons under nineteen years of age records one only, and that in a youth of eighteen. It is very probable, however, that the small, yellow, and indurated foci found in various parts of the brain by Chiari and others are gummatous.

Chronic hydrocephalus is sometimes of syphilitic origin. Ruffer in a careful review of the literature says that it is mentioned as the cause in 20 per cent. of the cases. Mendel regards it as a frequent cause. Lancereaux speaks of a syphilitic woman who gave birth to several hydrocephalic children. The anatomical cause of the condition is, according to Sandoz, inflammation of the ventricular ependyma and plexuses. In some instances, as in a case reported by Negree, instead of the usual thinning of the cranial bones they are much thickened. Heubner reports a case in which the enlargement of the skull was found post-mortem to be due not so much to dilatation of the ventricles as to a pachymeningitis hæmorrhagica.

Paraplegia may result from disease either of the cord and its membranes or of the spinal column. Fournier records a case of hyperostosis affecting several of the dorsal vertebræ and causing symptoms of compression myelitis. Many signs of syphilis were present, and the patient improved under specific treatment. Laschkewitz cured in two months a palsy of all the extremities due to a similar condition in the cervical region. We have no positive knowledge whether distinctly syphilitic lesions occur in the spinal cord in the inherited disease, or whether the inheritance acts only as a strong predisposing cause. So far as we have been able to learn, no autopsy has ever been made in a case of purely cordal inherited syphilis.

Dixon Mann reports a case in a boy fifteen years old who, after two years of progressing weakness in the legs, became completely paraplegic and anæsthetic. Muscular rigidity, increased reflexes, girdle pain, paralysis of the bladder, and a slight bed-sore were present. Fever was absent. The patient recovered after four months' treatment. The author considered the symptoms to be due to thrombosis with circumscribed softening.

In none of the cases of Friedreich's ataxia recorded in Griffith's paper, and in none which we have seen, is there clear evidence of inherited syphilis, while almost all of the few known cases of *locomotor ataxia* occurring in children had distinct hereditary taint. Remak and Fournier detail several such.

Moncorvo relates three cases of *disseminated sclerosis*, two of which improved under specific treatment. Ozenne relates a case of latent infantile syphilis which was treated for some time for infantile palsy, and which presented the symptoms of that disease, except that fever was continuously present. A month's specific treatment resulted in recovery. True acute anterior poliomyelitis rarely occurs in children with such hereditary taint.

Eustace Smith describes a peculiar form of *palsy* which affects the *anterior branches* of the *brachial plexus*. It causes a more or less complete palsy of the arms, sensation and temperature remaining normal. He quotes two cases from Henoch in which the flexor muscles of the fingers alone retained slight traces of contractility. Under specific treatment the palsy disappeared. In some cases a peculiar twisting of the head backward has been noticed when the child has been placed in a sitting position.

Some years ago Sinkler reported cases of *chorea* occurring in syphilitic children, and others have been reported since. The total number is, however, so very small—in Rachford's 61 cases, for example, there being only 1 with a syphilitic family history—that the relation cannot be more than coincidental.

The *peripheral nerves* are quite apt to be affected, the lesion being either gummatous or inflammatory. Nettleship reported to the Pathological Society of London a case of a girl in whom there was palsy of the third, fifth, and sixth nerves on one side. She was under observation for four years, during which time the condition persisted. Hutchinson relates two cases of ophthalmoplegia externa, in one of which optic atrophy was present. Bury and Barlow speak of two cases in which the seventh nerve was involved. In one there was found post-mortem symmetrical gummata on the third, sixth, seventh, and eighth pairs. Lawford reports two cases of ocular palsy, and quotes one from von Graefe in which there was complete palsy of the third nerve.

It is probable that the form of deafness described by Hutchinson as occurring within a few years of puberty, and being bilateral, painless, and without discharge, is often due to disease of the internal ear or the nerve.

The most remarkable case of spinal-nerve disease is that reported by Omerod, in the person of a woman twenty-three years old with a tumor of the median nerve, probably gummatous.

Examination of the cases given above will show conclusively that inherited nervous syphilis is not a disease confined to infancy, but that, on the contrary, the symptoms may first appear at puberty or even later.

Idiocy is rarer than would be expected. The probable explanation is that given by Fournier—namely, that the lesions which would cause it are apt to be fatal. Shuttleworth and Beach found syphilitic taint in only 28 of 2380 cases which they investigated. Ireland regards it as rare. Mental disturbance coming on after infancy is more common. Many cases present the same symptoms as are found in birth-palsy—spastic paralysis, fits, and weak-mindedness. According to Barlow and Bury, juvenile dementia is more often due to syphilis than is usually recognized. Under the title of "general paralysis occurring about the period of puberty" Wiglesworth speaks of eight cases, the two most prominent causative factors being hereditary and congenital syphilis. Mendel reports a case of mania with hallucinations occurring in a child fifteen years old.

Diagnosis depends entirely upon the history and the presence of signs of syphilis. There are no pathognomonic symptoms. There is a form of syphilitic pseudo-paralysis, the so-called Parrot's disease, which may be supposed to be of nervous origin if careful examination is not made. The apparent palsy, which may be monoplegic or diplegic, comes on spontaneously after birth without fever or convulsions and unaccompanied by any trophic changes. Examination will reveal that there is hyperostosis of the long bones or crepitation at the epiphyses from spontaneous fractures. Parrot believed the condition to be almost always incurable, but this has been disproved in quite a number of cases.

Treatment is the same as in the acquired disease.

INFANTILE CEREBRAL PALSIES.

By FREDERICK PETERSON, M. D.,

New York.

The infantile cerebral palsies are symptoms of a variety of pathological lesions in the brain, just as in adult life such paralyses depend upon processes of different kinds taking place in various regions at different levels in that organ. We may have a *monoplegia* of the face, arm, or leg, or a *hemiplegia*, or a double hemiplegia (*diplegia*); or we may have the two lower extremities affected (*paraplegia*), for the amount of paralysis depends upon the extent of the lesion. The cerebral palsies of early life, then, are symptoms merely, and our most important duty in connection with them is to discover the nature of the lesion which causes them, and to localize the seat of the pathological process within the brain. But while the paralysis is the paramount symptom of the destructive process occurring in the brain, there are many concomitant clinical conditions which it behooves us to recognize and study. As a basis for this article I shall make use of a paper by Dr. Sachs and myself, published in the *Journal of Mental and Nervous Disease* for May, 1890, in which one hundred and forty cases were analyzed; and, in addition, shall include the results of my personal observations of considerably over one hundred cases studied at the Vanderbilt Clinic, in my nervous wards at Charity Hospital, and in private practice, making a total of about two hundred and fifty cases. There have been added to the literature since 1890 many valuable articles, clinical, pathological, and therapeutic, dealing with these palsies, from which I have drawn liberally such material as has been deemed useful.

The French are the earliest contributors to the study of these palsies. In 1827, Cazauvielh published a paper upon the palsies appearing shortly after birth, and described the pathological conditions which he found in the brain in six autopsies. He speaks of a primary idiopathic agenesis and of a form of agenesis secondary to a variety of cerebral disorders. Dugès, Breschet, and Cruveilhier about the same time and later contributed to the study of the atrophied brains of children, though Cotard did more than other Frenchmen to elucidate the pathology of the infantile cerebral paralyses. He found cerebral atrophies to be accompanied by yellow plaques, cysts, cicatrices, cell-infiltrations, defects, and primary or secondary diffuse lobar sclerosis. The earliest German writer upon this subject was Henoch, who in 1842 wrote *De Atrophia Cerebri;* while the earliest English writer to describe these palsies was Little; and the earliest American, Sarah McNutt. While these are mentioned as the pioneers in the unravelling of the mysteries surrounding these disorders, there have been contributions of enormous importance by many authors of different nationalities. Kundrat in 1882 produced an able dissertation on porencephaly, a name given by Heschl to the defects of brain-substance found in many such cases. Kundrat differentiated between congenital and acquired porencephaly,

and ascribed the origin of these defects to anæmic necrosis from circulatory disturbances. Audry added much to our knowledge of porencephaly by the collection of 103 cases, while Bourneville, Richardière, Wuillamier, and Jendrássik and Marie, on the other hand, carefully studied lobar sclerosis. Strümpell endeavored to explain most cases of spastic hemiplegia of children by his theory of an acute porencephalitis, but this theory is now altogether rejected in the light of recent research, especially that of Sachs. Heine, Benedikt, Bernhardt, Wallenberg, Kast, Hoven, Möbius, Feer, P. Marie, Gaudard, Gibotteau, Ross, Hadden, Gowers, Abercrombie, Ashby, and Freud and Rie, in Europe, have all at various times made valuable additions to our clinical and pathological knowledge of these disorders. In America, Weir Mitchell, Hammond, Sinkler, J. Lewis Smith, Knapp, Lovett, Gibney, J. Madison Taylor, and Imogene Bassette have materially increased the literature of the subject, while the monograph of Professor Osler is a rich storehouse of clinical and pathological facts relating thereto.

Statistics.—The relative frequency of the cerebral palsies of early life, as compared with the infantile spinal palsies, is in the proportion of more than one of the former to two of the latter, so that it is a much commoner malady than has generally been supposed. Boys are somewhat more frequently afflicted than girls. In 452 cases collected to determine the relative frequency of the various forms, there were 332 cases of hemiplegia, 73 of diplegia, and 46 of paraplegia. Cerebral monoplegia is extremely rare, there being only 1 in this entire number. In hemiplegia the right and left sides are about equally affected, the difference in favor of the right being very small. Thus, of the 332 cases of infantile hemiplegia, 175 were of the right and 157 of the left side. In bilateral hemiplegia or diplegia usually all four extremities were affected, but occasionally only three (both legs and one arm). As contrasted with the cerebral palsies of adult life, the enormous frequency of diplegias and paraplegias in the cerebral palsies of early life is striking.

As regards the *age at onset*, most cases of diplegia and paraplegia are congenital, while most cases of hemiplegia are acquired after birth. Two-thirds of the acquired palsies have their onset during the first three years of life. But it is worth while to remember that at least 17 per cent. of infantile hemiplegias are congenital. With Sachs, I found 5 cases where the hemiplegia occurred at the age of eight years, and 4 cases between eight and fifteen years of age; while Osler gives 14 cases with an onset between the ages of four and ten years. It is a fact, however, that cerebral palsies are often congenital in origin, though the symptoms may not become apparent until some three or four months after birth, so that doubtless many are ascribed to the first year of life which had their origin during intra-uterine existence or at the time of labor.

Etiology.—The infantile cerebral palsies fall naturally into three groups: I. Those which have their inception during intra-uterine life; II. Those which result from injury at parturition; III. Those which are acquired subsequent to birth.

The *palsies of prenatal origin* are numerous. Trauma to the mother during gestation is a frequent cause of injury to the cerebrum of the fœtus. Serious diseases affecting the mother while carrying the child are common causes, particularly such as are septic in character or interfere with the normal circulation. Thus, fevers like typhoid, pneumonia, uræmic conditions, convulsions, and similar affections have in my experience resulted in maldevelopments of the fœtal brain. Fright also has seemed, in one or two cases, to have brought about such a catastrophe, and doubtless other psychical strains may

produce like results. Premature birth at the seventh or eighth month was a coincidence in four or five congenital cases. Syphilis is extremely rarely a cause in congenital cases.

The chief cause of the cerebral *paralyses occurring during parturition* is undoubtedly tedious labor. Delivery is especially apt to be slow in primiparæ, and the older the primipara the more tedious is the labor usually. In such cases the long-continued pressure upon the head is apt to work mischief to the child's brain. While instruments are often employed in precisely these conditions, and sometimes themselves cause injury to the cranium, it is quite certain that the effects of compression in tedious labor are more commonly the cause of congenital paralysis and idiocy than the application of forceps—a point that the obstetrician should keep in mind.

The third group of cerebral palsies of children, the *acquired paralyses*, have a great variety of etiological factors, chief among which are the acute infectious diseases of childhood, giving origin to about 20 per cent. of all cases. These palsies may follow measles, scarlatina, small-pox, typhoid fever, whooping-cough, vaccinia, pneumonia, cerebro-spinal meningitis, gastro-enteritis, and tonsillitis. In pneumonia and whooping-cough the strain and engorgement produced by the coughing are probably important factors in the production of the palsy. Other causes of the acquired palsies are simple fright, trauma to the skull, hereditary syphilis, the status epilepticus, and infantile convulsions. There is no evidence of the existence of an acute polio-encephalitis analogous to poliomyelitis.

Symptoms.—Onset with *convulsions* is exceedingly common, the convulsions sometimes being a concomitant symptom of the brain lesion, and sometimes the actual cause. Since so large a proportion of the cerebral palsies of early life are due to lesions affecting the cortex, it is not surprising that convulsions should be so frequently observed. For the same reason *coma* is very common at the onset of the paralysis. The repetition of convulsions as the disorder progresses, especially in the form of epilepsy, is the strongest indication of involvement of the cortex in the pathological process.

The *form of the paralysis* is either monoplegia, hemiplegia, bilateral hemiplegia, diplegia, or paraplegia. The first mentioned is extremely rare. In hemiplegia the leg recovers more rapidly than the arm, as in the adult, but in rare instances the leg is, and remains, more affected than the arm. While the face is frequently included in the paralysis, it rarely continues to be paralyzed, but is among the first parts to recover. Traces, however, of facial paralysis may often be discovered in these cases on close investigation. Strabismus is found at times in all the forms of infantile cerebral palsy.

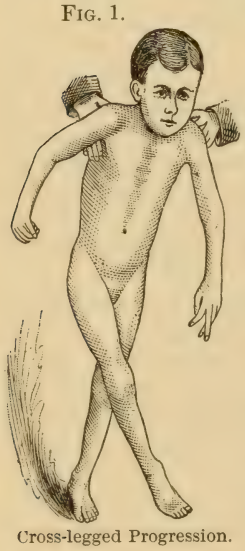
In children that have learned to talk, *aphasia* may accompany the palsy, probably quite as frequently a left as a right hemiplegia, for the motor speech-centre does not seem to be specialized in the left hemisphere during the early years of life. But a defective development of articulate speech is common in all forms, and particularly in the congenital cases and the earliest acquired cases.

I have observed *hemianopsia* in two or three cases of infantile hemiplegia, and Henschen has noted several such in his great work. Freud has described two. In the great majority of cases the *reflexes* on the affected side (knee-, elbow-, ankle-, and wrist-jerks) are exaggerated, but in about 5 per cent. they may be normal, diminished, or absent in the paralyzed extremities. Sometimes they are difficult to obtain on account of rigidity and contractures. This is especially true of ankle-clonus and the triceps-jerk. Frequently the deep reflexes are exaggerated also, as in the adult, in the normal as well as in the

paralyzed extremities; nevertheless, they are more marked in the parts involved in the palsy.

Morbid movements are remarkably common in the paralyzed muscles of hemiplegic and diplegic children. The most frequently observed of these motor disturbances is *athetosis*, occurring in some 20 per cent. of all cases of hemiplegia, and occasionally in diplegia. Next in point of frequency are *associated movements;* that is, the more or less exact imitation by the paralyzed hand and fingers of voluntary movements made by the normal hand and fingers, and *vice versa*. Such associated movements are to be observed in healthy children, the tendency in childhood being to make use of the two hands simultaneously; but in cerebral palsy this tendency is often so greatly exaggerated that such nicely co-ordinated movements as are required in writing and buttoning, when executed by the sound hand are closely imitated by the affected hand. *Choreiform movements* are found in some 5 or 6 per cent. of the hemiplegics, but are much more rare in diplegia. *Ataxia*, *rhythmical contractions*, *tremor*, and *tetanoid contractions* are occasionally to be noted. *Nystagmus* is found apparently only in cases of diplegia. I have remarked nystagmus in three, and Osler, in two such cases. I have recently described as present in two congenital hemiplegias a hitherto unnoted morbid movement to which I have given the name *post-hemiplegic polymyoclonus*. The movements are neither choreiform nor athetoid, but are constant clonic contractions of most of the muscles in the limbs affected, not occurring synchronously, and the rhythm being about that of paralysis agitans (five per second). All of these movements indicate interference with motor conduction due to lesions in some part of the voluntary and inhibitory tracts.

Fig. 1.



Cross-legged Progression.

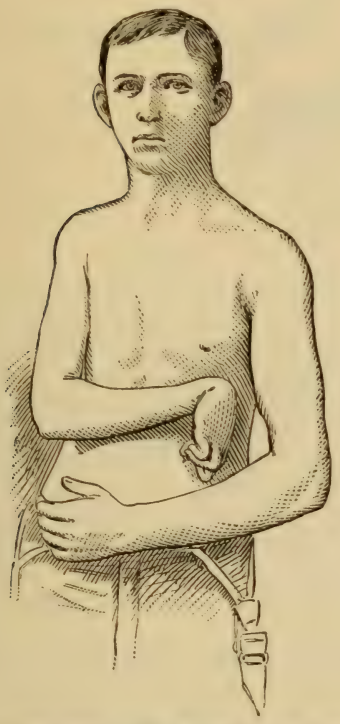
Rigidity and contractures are striking symptoms in almost all these palsies, and for this reason they often fall into the hands of the orthopædic surgeons, who are besought to remedy the rigidly-flexed elbows, wrists, knees, and the various deformities that interfere with locomotion. Adductor spasm in the thighs, causing cross-legged progression, is nearly constant in diplegia and paraplegia. Talipes equino-varus is the most frequent pedal deformity in hemiplegia. Double talipes equino-varus is observed at times in both diplegia and paraplegia. Rarely talipes equinus and talipes equino-valgus are to be found in hemiplegia. While rigidity with contracture is the rule in all of these forms of infantile cerebral palsy, occasionally, but very seldom, cases will be met with in which the muscles are all completely flaccid.

The chief *trophic disturbance* encountered in these cases is retardation in growth of the paralyzed members. The paralyzed limbs do grow, but at a much slower rate than the sound extremities. Hence the disproportion is often very striking. The earlier the onset of the palsy, the greater is this disproportion. Another peculiarity that I have noted is that the growth of the whole organism is to a certain extent interfered with, the injury to the brain seeming to stunt development and to prevent the patient attaining his normal stature. The patients are more or less undersized and dwarfed. This point was particularly made evident to me in a case of hemiplegia. The mother brought to me her two boys, twins, six years of age, for the examination of the

one affected. One was a tall, well-built lad; the hemiplegic boy was small-bodied and fully seven inches shorter than his healthy brother. In all of these cases the muscles of the paralyzed and undeveloped extremities react normally to the faradic current. In many cases the affected limbs may be blue and cold, as in paralysis of the spinal type. A very rare phenomenon in these cases is a hypertrophy of the muscles, usually combined with athetosis.

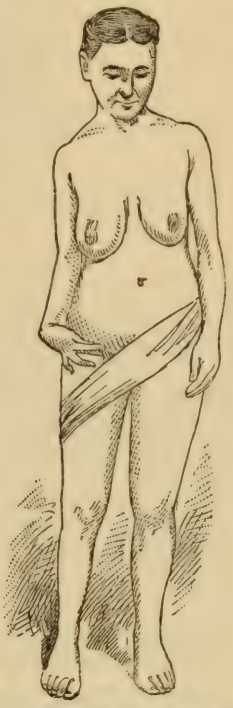
Epilepsy is undoubtedly the worst feature of these cases, affecting as it does over 45 per cent. of all forms. In the hemiplegic form fully one-half of the

FIG. 2.



Right Hemiplegia, with contracture and retarded growth of arm.

FIG. 3.



Right Hemiplegia, from age of nine months, in a woman thirty-six years; contracture and retarded development of paralyzed side.

cases suffer from epilepsy, in diplegia 30 per cent., and in paraplegia 36 per cent. of all cases. In most of them the epileptic seizures are general, but about 15 per cent. of the cases of infantile cerebral palsy suffering from epilepsy exhibited the Jacksonian type of seizure. I have observed *petit mal* in two or three cases. A very important fact has been brought out in this connection, and that is that many cases that have been diagnosticated as epilepsy alone are, upon close and careful investigation, found to present traces of a palsy often so rudimentary in character that it has escaped attention. In all cases of what appears to be idiopathic epilepsy search should be made for the residua of paralyses. There are undoubtedly cases of genuine epilepsy having its origin in similar pathological processes which beget the palsies of early life, yet in which no vestige of the organic lesion may be discovered at all. It would naturally be expected that as most of the lesions causing cerebral paralyses in early life are cortical, the epilepsy would be Jacksonian rather

than general, but the contrary is the case. The reason for this is that the original focal lesion disappears, and a general atrophy and sclerosis take its place.

Feeble-mindedness, *imbecility*, and *idiocy* in connection with these palsies are more frequently observed even than epilepsy. The proportion of mental enfeeblement is in a direct ratio to the extent of the pathological process, and hence in the diplegias and paraplegias a large degree of imbecility and idiocy is

FIG. 4.



Paraplegia: Photographed in Epileptiform Convulsion.

usually encountered, for here both hemispheres are involved. In hemiplegias, on the other hand, idiocy is relatively rare, though the lower degrees of feeble-mindedness and imbecility are to be noted in nearly one-half of all cases.

Among the *physical defects*, or *stigmata degenerationis*, are often found various cranial deformities, such as asymmetry of face and skull, microcephalus, leptocephalus, macrocephalus, and cranium proganæum. The Gothic palate, imperfectly developed or supernumerary teeth, hirsuteness, and deformed ears are other physical evidences of imbecility and idiocy at times encountered. I have, in a paper with Fisher, called attention to the flattening of the skull often observed on the side opposite the paralysis in infantile spastic hemiplegia.

Pathological Anatomy.—It is seldom that cases of infantile cerebral palsy come to autopsy at the time, or near the time, of their onset, while there are large numbers that have been carefully studied and described after the late secondary pathological changes have become manifest. But it is precisely the initial lesion that it is very important to understand. For a full discussion of the pathology I would refer the reader to the original paper written by Dr. Sachs and myself, and in particular to the chapter on "Cerebral Hæmorrhage, Thrombosis, and Embolism," by the former, in Keating's *Cyclopædia of the Diseases of Children*.

At the post-mortem examination the physician usually finds atrophy of a part of the brain, evidences of sclerosis, one or more cysts, or the condition known as porencephalus. All of these are terminal conditions. Cysts are secondary, as a rule, to hæmorrhage. Porencephaly may follow upon hæmorrhage, upon anæmic necrosis, or upon other long-antecedent processes. Atrophy and sclerosis, too, are the results of a variety of initial lesions, such as hæmorrhage, thrombosis, and embolism. While it is barely possible that encephalitis may be a forerunner of some of these terminal conditions, there is not sufficient evidence of the existence of the polioencephalitis of Strümpell to establish it as a fact. We may group the pathological processes, after Sachs, as follows:

Groups.	Pathological Changes.
I. Paralyses of intra-uterine onset	Large cerebral defects (true porencephaly). Hæmorrhages of intra-uterine origin (softening?) Agenesis Corticalis.
II. Paralyses occurring during labor . . .	Meningeal Hæmorrhage (very seldom intracerebral). Resulting conditions: meningo-encephalitis chronica; sclerosis; cysts; atrophies (porencephalies).
III. Paralyses acquired after birth	Meningeal Hæmorrhage (very seldom intracerebral); Embolism; Thrombosis (in marantic conditions and occasionally from syphilitic endarteritis). Results of these vascular lesions: cysts; softening; atrophy; sclerosis (diffuse and lobar). Chronic Meningitis. Hydrocephalus (seldom the sole cause). Primary Encephalitis (Strümpell) (?)

The pathology of the congenital cases is very clear. In a certain number of cases there is *defective development*, so that often large portions of the brain are wanting. These defects are possibly due to vascular disorders during fœtal life. In other cases the defects are circumscribed, and the chief seat of these lesions is the motor areas. That hæmorrhages in the fœtal brain during gestation may occur is proven by a case of Cotard. Sometimes the defects are not gross and large, but evident only upon close scrutiny, or are even microscopic. Such instances are the confluence of fissures, simplicity of configuration, exposure of the island of Reil, and the like. In these the chief feature is defect in the highest nerve-elements, the cortical cells, a veritable *agenesis corticalis*. In all such cases of defective development, whether gross or microscopic, idiocy is a marked symptom, while epilepsy is rarely if ever present. The absence of epilepsy may therefore be cautiously considered as an evidence of the nature of the lesion; it seems to prove a simple maldevelopment, an active process being thus excluded.

Meningeal hæmorrhage is the chief cause of all cases of cerebral palsy occurring during labor, although at autopsy the conditions found may be chronic meningo-encephalitis, sclerosis, cysts, atrophy, or porencephaly. These hæmorrhages are produced by the compression which the head undergoes in the pelvis during parturition. In this connection I cannot forbear referring to the recent researches of Herbert R. Spencer. Among 130 stillborn children he found 4 cases of thrombosis of the longitudinal sinus, 1 of intracerebral hæmorrhage, and 53 of hæmorrhage from the pia and arachnoid; 29 times there was bilateral hæmorrhage, 10 times in the right side of the brain only, 10 times in the left, 7 times into the lateral ventricles, and 6 times limited to the base of the brain. He finds the frequency of central hæmorrhage greatest with forceps delivery, next with breech presentation, and least with natural head presentations. He believes that softness of the skull-bones and their increased mobility may be determining factors in the production of hæmorrhage. In 30 cases he found hæmorrhages into the spinal canal and cord, and I cannot but believe that some, though a very small percentage, of the cases of paraplegia especially, and perhaps diplegia, may be due to cord lesions at birth after all, and not to cerebral lesions. Otherwise it is difficult to explain the great intel-

ligence and freedom from epilepsy, athetosis, and the like, of a select few of the palsies of these forms.

As regards the third group, or the acute acquired palsies, *hæmorrhage*, *embolism*, and *thrombosis* are the chief causes of cerebral paralysis in children after their birth, just as they are in the adult. We have apoplexies in childhood as in later life. I have named these causes in the order of their frequency. Sachs and myself collected and analyzed the results of 78 autopsies in infantile hemiplegia as follows:

Lesions Found.	No. of Cases.
Terminal conditions:	
Cysts, atrophy, sclerosis	40
Porencephaly	2
Hæmorrhage	23
Embolism	7
Thrombosis	5
Tubercle	1
Total	78

It would be impossible to determine the initial lesion in the terminal conditions cited in the above table, but doubtless most of these also were vascular in their nature. Hæmorrhage in children and adults differs both as to cause and position. In adults, as is well known, the bursting of miliary aneurisms in atheromatous vessels is the common cause of hæmorrhage. Miliary aneurisms, as well as large ones, are occasionally found in children, but in them fatty degeneration of the vessel-walls, as described by Von Recklinghausen, is more frequent. In adults hæmorrhage generally takes place in the neighborhood of the internal capsule; in children, in the meninges and about the cortex. Exceptionally, intracerebral hæmorrhages do occur in childhood. In the paralyses following acute rheumatism, endocarditis, and scarlet fever, it would be natural to suspect an embolic process, as in the adult; and in hereditary syphilis and marantic conditions thrombosis would be the lesion most likely to supervene; but as compared with hæmorrhage both embolism and thrombosis must be looked upon as rather infrequent causes.

The pathological process here described as so common in children may occur, it must be remembered, without producing paralysis; for where other parts than the motor areas are involved other symptoms may result, such as epilepsy alone or the various degrees of idiocy. A beautiful case in point was one sent to the Vanderbilt Clinic some two years ago, a young girl with epilepsy and a left homonymous hemianopsia, congenital in origin, showing undoubtedly a cortical lesion over the right occipital region (reported by M. Allen Starr).

Differential Diagnosis.—The hemiplegic, diplegic, or paraplegic form of the paralyses, the rigidity, the exaggerated reflexes, the normal electric reaction of the muscles, the absence of actual atrophy in the limbs, the presence of epilepsy or idiocy or of morbid movements of one kind or another, usually serve to easily distinguish this disorder from infantile spinal paralysis. It would be only in some of the mildest types of either of these affections, or in the case of a monoplegia, that any difficulty might present itself; and even here some one or two of these indications would suffice for a diagnosis. It is a fact, however, that in many cases of epilepsy, athetosis, chronic chorea (especially hemichorea), and in some of imbecility or idiocy, a hemiparesis is often overlooked.

Prognosis.—Death as a result of infantile apoplexy is very rare. The duration of life in such palsies is generally short. Few cases of diplegia and paraplegia reach the age of twenty years. A certain small number of hemiplegics may attain the age of forty years. In most cases it may be stated that

the face will recover, and that the leg will become sufficiently useful for locomotion. In the bilateral palsies the prognosis as regards walking cannot be quite so favorable. Except in the severest forms speech will be recovered more or less perfectly. After the lapse of a few months an idea can be obtained as to the mental state, and as to whether imbecility or idiocy is to be apprehended. The probability of epilepsy is the feature in prognosis requiring the greatest exercise of judgment. Epilepsy may not appear for a year or two after the onset of the paralysis, and the statistics already given as to the enormous percentage of these cases thus affected must be borne in mind.

Treatment.—In cases seen shortly after birth, showing symptoms of cerebral lesion, quiet and careful handling are the chief indications. Minimal doses of bromide of potassium or chloral, or chloroform inhalation may be employed if convulsions occur. In the initial stages of the acute acquired palsies we treat the infantile apoplexy in much the same manner as we would apoplexy in the adult. Absolute quiet, cold applications to the head, and emptying of the bowel are the first steps in treatment. In a few days the bromides may be used to ensure greater rest to the brain, and subsequently, combined with an iodide, continued for some time, though not so long as to interfere with nutrition. In the chronic stages relief is generally sought for secondary conditions, such as deformities from contractures, and idiocy and epilepsy. Excellent results are achieved by tenotomy and orthopædic apparatus properly applied for the correction of the various deformities, particularly of the lower extremities. In one case in this city athetosis in the right arm was so extreme that the limb was amputated at the shoulder, to the great relief of the patient. Electricity (especially the faradic current) may be used to exercise the paralyzed muscles, and, combined with massage, may go far to prevent and remedy contractures.

The epilepsy is treated with the usual agents, the bromides, chloral, and the like, though, it must be confessed, without much success. To remedy the mental defects very much can be done by careful manual and intellectual training. In fact, surprising results are often achieved in the development of the mind, speech, capabilities, and character of these cases when placed in schools especially adapted for such purpose, as is evidenced by the experience at Bicêtre and some of the private schools in this country.

As regards surgical procedures in any of these cases, either for relief of epilepsy or for the improvement of the mental condition, the most that can be said at the present time is that, upon the whole, little or nothing is to be expected from trephining, craniectomy, and the like. Possibly future experience may justify operative interference in a small percentage; but the great majority of infantile cerebral palsies are better left to the treatment of the family physician, to the orthopædic surgeon, and to the developmental influences of special schools. M. Allen Starr states, in a very recent paper, that he has collected some fifty cases of operations in these and allied conditions (like microcephalus). Many of these he publishes in a list, and an examination of his table showing the results obtained is certainly not very encouraging. In addition to these, Sachs gives notes of three of his own cases operated upon, all hemiplegics with epilepsy, in two of which the seizures returned after operation in three and six months respectively, and the other was not seen after three months, up to which time no attacks had supervened. Wildermuth, however, reports two cases of hemiplegia with epilepsy, in which the seizures seemed to have ceased, one having not been observed for three years and the other ten months subsequent to operation. Besides the apparent futility of cerebral surgery in most of such cases, children do not undergo these operations with as little danger as adults, and the proportion of deaths in the cases thus far published is rather large.

SPEECH DEFECTS AND ANOMALIES.

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Physicians are frequently consulted with reference to absence, deficiency, or peculiarity of speech in children at different ages from birth to puberty, but particularly in those under six or seven years old. Healthy infants acquire articulate speech at varying ages, according to inherited qualities, the general health, the influence of some acute disease, or the surroundings of the child. The child of deaf and dumb parents, or one placed where it hears or sees but little, or one not much thrown into the company of talking adults or older children, may be delayed in the initial stages of articulate language. Sometimes at the age of nine or ten months unusual precocity is shown. Ordinarily, about the end of the first year or the beginning of the second, parents and physicians look for some decided efforts at speaking, and when eighteen months or two years have been reached without these, anxiety begins to be experienced and inquiries to be made. The problem presented is by no means a simple one. The physician must carefully weigh a number of facts and must investigate from a variety of standpoints. Starting with the peripheral apparatus of speech and proceeding toward the central nervous system, he must examine into the muscles and nerves of articulation, phonation, and respiration; the external and internal apparatus of hearing, the nuclear centres of several of the cranial nerves; and the hearing, speech, and visual centres of the cerebrum and their commissures. He must fully consider the mental status of the child, and if this be settled adversely, the rest may need little attention; but if not so decided, then, step by step, each of the parts and processes concerned directly or indirectly in the mechanism of speech must receive close scrutiny.

Is the child idiotic or imbecile? Is it suffering from aphasia, congenital or acquired at or since the time of birth? Is the speech loss due to brain arrest? Is the child simply backward in speech? Is it suffering from some functional or hysterical affection? Is the child a deaf-mute, and, if so, what is the character of this deaf-mutism? Is it dependent upon periosteal or bone disease? Is it the result of old or recent inflammatory disease of the ear, either primary or the sequel of some acute infection, as scarlet fever or measles? Is the deficiency of speech due to paralysis of any of the nerves or muscles of articulation? Is it a spasmodic affection of these nerves and muscles? What is the shape and size of the oral cavity, and, if deformity of the vault of the palate, of the pharynx, or of any part of the oral cavity be present, is it or is it not associated with true idiocy and imbecility? Is, as mothers so often wrongly imagine, the child tongue-tied, the frænum being so attached as to prevent free movements of this organ? Are adenoids or other growths or enlargements present?

Speech Defects due to Idiocy or Imbecility.

Dysphrasia, a term applied by Kussmaul (*Ziemssen's Cycl. Pract. Med.*) to defective or absent speech due to intellectual impairment, is more frequent in children than any of the varieties of aphasia, but is of course usually then an accompaniment of idiocy or imbecility. The child cannot speak, or talks imperfectly or foolishly because of an absence or deficiency of ideas; it does not speak, as Griesinger has said, because it has nothing to say. It does not know anything that would be ordinarily transmuted into language. Even in idiocy the cortical organs of speech, considered as special areas, are doubtless often arrested or diseased, but in addition other parts of the brain concerned in mentation may be lacking or altered. As is well known to those connected with institutions for the feeble-minded, not a few cases with some intelligence cannot by the greatest perseverance be taught to speak; some can be taught a few words and sentences, but cannot get beyond a certain point, which is limited by their ability to assimilate knowledge. Others perhaps can be taught, parrot fashion, to repeat words or even phrases or sentences of the meaning of which they have no idea. Many interesting observations upon the development of speech have been made in all such institutions. Physicians will be called upon to give opinions not only as to arrest of mental growth, but also as to the capabilities of future development in such children; and such opinions can be only of value when they are based upon a close study of the conditions present at the time of examination, and of the life and family history of the child. Mierzejewsky, cited by Kussmaul, has described in great detail the history of an aphasic idiot who lived to be about fifty years of age, and whose mental powers and speech were about as developed as those of a one or one and a half year old boy. He could only give utterance to a few of the simplest syllables. His brain was examined, and resembled in the shape and the arrangement of the convolutions that of a human fœtus of the ninth month. The methods of diagnosticating idiocy and imbecility will be considered in the next section, and it will therefore not be necessary to call further attention to this subject here.

Aphasia.

The term "aphasia" is sometimes carelessly applied to almost any variety of speech disorder, but it is best restricted to the description of complete or incomplete loss of speech from a local cerebral affection. It is conveniently divided into motor or expressive and sensory or receptive aphasia, and these have special forms, some of which need to be borne in mind even in studying the disorders of speech from which children suffer. Sensory aphasia has several varieties, as word-deafness and word-blindness, which define themselves, and apraxia or mind-blindness, in which the ability to recognize the use or meaning of an object is lost. Aphasia may be both sensory and motor, as when the receptive and emissive sides of the brain are both involved in disease. Agraphia is loss of power of writing; amimia, inability to express thought by signs and pantomime. Besides varieties of aphasia resulting from cortical lesions, others may be due to destruction or interference with the commissures or lines of connection between various centres, and these are known in general terms as paraphasias or conduction aphasias. Alexia is abolition of the power of reading, as agraphia is that of writing; dyslexia refers to difficulty or fatigue in reading; paralexia, to the misuse by transposition or substitution of either words or syllables, while paramimia is the misapplication of signs

or pantomime. Whether a child can have alexia, dyslexia, agraphia, or amimia will of course depend on its acquirements—on its ability to read, to write, to talk, or to express itself by gestures or pantomime. Children under six or seven years old would need to be studied from different standpoints from those over this age, and children between six and ten would need a consideration which would differ for those from ten to fourteen.

True aphasia is sometimes congenital: a deficiency of speech not dependent upon lack of general intellectual power may be present, or, in other words, a distinction can sometimes, although perhaps rarely, be made between a dysphrasia and an aphasia of prenatal origin. Broadbent (cited by Kussmaul) has reported an interesting case of congenital aphasia in an intelligent boy. When twelve years of age he understood everything that was said to him and did what he was told to do, but could not, as a rule, say anything but "Yes," "No," and "Father" and "Mother," pronouncing the last two words imperfectly. He used also an indirect expression in answer to all questions; occasionally he uttered a few other words, such as "All right!" "Thank you," and he had other interesting peculiarities. A few cases have been reported which seem to show that the arrest of the organs of articulation was the particular condition present, as one in which the idiot could utter only a few scarcely intelligible words, but could express himself well by an animated and intelligible pantomime, and was even able to report on different things that occurred in the asylum.

Aphasia the result of acute lesions occurring after birth is rare in children as compared with adults, as hæmorrhage, embolism, and thrombosis are of infrequent occurrence in childhood. Of the three, embolism as an accompaniment of rheumatism or endocarditis is probably the most common. When a lesion does invade the speech-areas of the brain on the left side, the other hemisphere more quickly assumes the lost function than in adults. Sachs (*Keating's Cycl. Dis. of Children*) records seventeen cases of hemiplegia with aphasia. His experience is in accord with that of Bernhardt, who found that aphasia in children accompanied left as well as right hemiplegia. Other acute causes of aphasia in children are meningitis, tumor, and abscess. Occasionally in tubercular meningitis a form of aphasia or paraphasia may be developed, and this particularly when the tubercular deposits or conglomerates are in and around the Sylvian fossa. Sometimes in basal meningitis in children, owing to inflammation and exudation in the pons-oblongata region, a form of dysarthria or articulatory paralysis will show itself.

The position and size of a neoplasm will determine how far speech or any of its elements or tributaries will be affected. Word-deafness may be present when the first and second left temporal convolutions or the white matter beneath and near these areas are invaded, although such word-deafness may soon in part be recovered from if the right hemisphere be intact. Word-blindness in a child that can read or write may result from a tumor situated in the zone where the left parietal borders the anterior occipital region. Of course a tumor of any description involving the hinder part of the left third frontal will cause more or less motor aphasia in a child that has acquired speech, and may arrest the development of the faculty in one of tenderer years. When the island of Reil is invaded, either aphasia or paraphasia may result.

Intracranial abscess sometimes is the cause of word-deafness or some other variety of aphasia in children. Such cases are usually associated with aural disease, as when purulent disease of the mastoid or of the tympanic cavity leads to meningeal inflammation and abscess of the temporal lobe.

Aphasia usually with, but sometimes without, monoplegia or hemiplegia may be a consequence of hereditary syphilis. These cases may have several attacks of aphasia with partial paralysis, sometimes affecting different sides of the body. The lesions are usually the outcome of endarteritis or chronic meningitis, particularly leptomeningitis, and in some cases they are forms of cortical sclerosis with atrophy. The child will often show some of the other well-known evidences of inherited taint, as notched or pegged teeth, cracking of the corners of the mouth, flattening of the nose and face, or interstitial keratitis. It is important to recognize the syphilitic origin of these cases, and to treat them accordingly with mercurial inunction, calomel, iodide or bichloride of mercury, or the iodides of sodium or potassium.

In children, as in adults, aphasia has been noticed in the course of typhoid and other fevers: probably in most of these cases the affection is not due to a local lesion, such as a clot or the closure of a vessel, but to a toxic influence exerted by the poison of the disease on the brain. Bassette (*Jour. Nerv. and Ment. Dis.*, July, 1892) has reported two cases of this kind, one in a girl nine years of age, who in the second week of typhoid fever became markedly deaf without middle-ear complications, and also had partial hemiplegia. The paralysis passed off, and she began to recover her speech about the sixth week. Another, a girl of five years, ceased to speak for eleven days.

Children, through fright or other cause, sometimes suddenly become speechless. Hysterical children also have attacks of mutism. Langdon Down (cited by Ashby and Wright in *Diseases of Children*) records the case of two brothers, who had spoken well and understood two languages, completely losing the power of speech at the second dentition.

In rare cases children who are not idiotic, and who are not suffering from either central or peripheral disease, are nevertheless exceedingly slow in learning to speak, and in particular for a long time may fail to acquire the proper method of articulating and pronouncing certain letters and sounds. Sometimes such children are otherwise intelligent, and eventually develop up to the full standard of mental health and activity. In some remarkable cases children, even to the age of ten or twelve, have habitually made use of only a few letters. Deferred or retarded speech development must be distinguished from congenital or acquired aphasia of more permanent type. According to Bastian, cases allied to congenital idiocy are observed, in which, owing to some intracranial lesion occurring before, during, or soon after birth, the child's mental condition is greatly degraded as well as his motor power. In some of the less severe examples of this type speech is merely deferred, perhaps until the fourth, fifth, or even sixth year, and may become after a time established in a natural manner. Bateman (*Aphasia, or Loss of Speech*, 2d ed., 1890) mentions a case of this tardy development of the faculty of speech which came under his observation. The child never spoke at all until he was six years old, and it was thought that he would remain dumb. At six years of age he began to talk, and was able to receive an education suitable to his condition in life, but he grew up to manhood a person of feeble intellectual and also of feeble physical power.

Echolalia and Coprolalia.

In the affections known as echolalia, coprolalia, and by various other names, convulsive or choreic movements are associated with a sudden explosion of speech. The patient with a grimace, contortion, or violent movement of some kind suddenly bursts into obscene, profane, or absurd expression. This

expression may be the echo of something overheard—hence the name, echolalia —or it may be a spontaneous outcry. It is not simply a hysterical affection, controllable and curable, but is a true monomania, the affection of speech being beyond the patient's volition; it could properly be discussed under morbid impulses as well as here. One patient of mine, a boy twelve years old, at times, without warning, would in a street-car or other public place, as well as in private, suddenly give utterance to a filthy expression two or three times, accompanying it with a violent movement of the head, shoulders, and one arm.

Deaf-mutism.

Deaf-mutism must be carefully distinguished from aphasia and other affections of speech. While some cases are congenital and associated with more or less profound idiocy, the number of these, according to good authority, does not equal those which can be fairly attributed to disease and accident after birth. Even congenital deafness and dumbness are sometimes due to peripheral causes, as to periostitis, ostitis, or imperfect development of the petrous bone. The semicircular canals or other portions of the internal ear may be wanting or altered by intra-uterine disease. Colloid degeneration of the labyrinth is said to be a frequent cause of the absence of hearing, and various diseases of different parts of the auditory apparatus, particularly of the internal and middle ear, may occur before birth. These cases must be separated from those of mutism or deaf-mutism associated with idiocy. A diagnosis may sometimes be made by careful physical examination and a study of the mental condition of the patient. Purulent otitis or, what is more difficult of decision, Voltolini's labyrinthine otitis, or some other form of labyrinthine non-purulent inflammation, may cause absolute deafness, and owing to this deprivation the child may be supposed to be mentally deficient. Indeed, such a child may, under unfavorable circumstances, fail to develop to any considerable degree. A process of experimental training of the senses which are left will sometimes enable a decision to be reached in a comparatively short time. The patient who is simply deaf-mute, from whatever peripheral cause, will under proper incitements be able to fix his attention and show intelligent interest in his surroundings.

The exact age under which a child will lose its speech because of loss of hearing cannot be absolutely fixed; but when total deafness is caused by purulent disease of the ear or other destructive affections before the age of six or seven years, the child is likely to become mute as well as deaf unless special training has at once been started, and even in spite of this a certain degree of loss or imperfection of speech will result. The original capacity and the acquirements of the child at the age when deafness occurs will of course have a bearing upon the question of deaf-mutism. Occasionally children who have had scarlet fever, measles, or infectious diseases at the age of two or three years, and have become totally deaf in consequence, are supposed to be idiotic. Such children, if naturally intelligent, will exhibit great interest in everything that comes within the range of the senses that are left. Slow or stupid children deprived of hearing and speech, particularly if treated with neglect or indifference, will sometimes sink into a state of inertia which simulates a true imbecility or fatuity, leaving them with defective mental powers. A physician should be acquainted with the usual time when a child of average mental capacity acquires the ability to respond to general sounds and noises, and then to special sounds, voices, and eventually to definite words, and also when it first gives vent to feelings of pain or pleasure, when it makes special response to particular sounds, when it imitates sounds connected or not connected with

ideas, and when, finally, speech becomes a method of expressing centrally initiated thought, no matter how elementary this may be. It is not as difficult, as at first sight might appear, to learn to follow and analyze such processes of development and to determine as to their retardation or advancement. Mothers acquire great facility in this way by comparison of the progress of their different children.

Preyer (*The Mind of the Child*, part I., transl. by H. W. Brown, 1889) has made a practical study of the development of the different senses and mental faculties, based largely upon the close study of his own child. According to him, the new-born are always deaf, because of temporary local conditions, such as lack of air in the tympanic cavity, collections of liquid or gelatinous substances in the middle ear, and closure by foreign matter of the external auditory canals. Whether this be absolutely true or not, it is certain that all healthy children in a few hours or in a day or two at least react to impressions of sound. Of fifty children who were tested by Mollenhauer, ten, less than twelve hours old, reacted to a brief disagreeable sound. Preyer was not convinced until the first half of the fourth day that his child was not deaf. In the eighth week he showed pleasure at piano-playing, and in the ninth the sound of a repeating watch aroused his attention to the highest pitch, while in the eleventh week he moved his head in the direction of the sound heard; and soon this was always done with great promptitude and certainty. After a half year he enjoyed single notes and military music, and soon he showed evidence of intellectual advance. After the first year the child rapidly advanced in his exhibition of logical activity in connection with hearing. The statement that children from three to four months old possess normally very slight capacity for hearing must be pronounced false, according to Preyer, for long before the third month the human voice is heard by the normal infant, and before the close of the first week normal children react to the stimulus of loud sound.

Kussmaul distinguishes three periods in the development of articulation. Within the first four months, and about the time of the earliest movements of prehension, children give vent to spontaneous sounds indicating their feelings of joy. These are chiefly lip and vowel sounds, but sometimes they are also lingual and palate sounds. In a second period these savage noises, are gradually crowded out by the conventional sounds of the national language, but even these are of a very simple character. Some of them are imitated and some are not. With the commonly used words *ma*, *ma*, and *pa*, *pa*, the child at first does not connect any idea, but by degrees learns to do this. At a third stage speech becomes an expression of thought, a child learning to associate certain definite objects with the words acquired by practice. All this may be accomplished in the most elementary way by the end of the first year.

"Sounds such as *m-m*, *ba-ba*, *da-da*," say Ashby and Wright, "may be repeated in a meaningless sort of way, but before long are applied to persons and things. During the second year the vocabulary increases fast, and the child quickly imitates and repeats the words it hears, so that by the end of the second year it not only uses a number of words, but can string together a few nouns and adjectives or has learned the meaning of short sentences. At this period, and for the next year or two, words are indistinctly or improperly pronounced, with a tendency to clip them short or to drop consonants. Some consonants present greater difficulty to the young child than others, and are constantly dropped out of words; thus *s*, especially when it precedes another consonant, is omitted, as *cool* for *school*, *kweek* for *squeak*, *no* for *snow*. Difficulties often arise with the aspirate dentals, as *th* and *sh*. *Ruth* becomes *roof;* the vibratory consonant *r* is a great stumbling-block, and the distinct pronun-

ciation of it is perhaps never acquired; *grub* is apt to become *gwub*, and *roof*, *woof*."

Affections of Speech due to Peripheral Paralysis.

After acute infectious diseases, and particularly after diphtheria, palatal or pharyngeal paralysis may be present. Occasionally an attack of diphtheria is overlooked or supposed to be some other throat affection, and even so-called latent cases sometimes result in forms of paralysis. Facial paralysis in children would be determined by the appearance of the face, and indeed the affection of speech in such cases is usually very slight. Lingual paralysis of peripheral origin is rare both in adults and in children.

Stuttering and Stammering.

The presence and meaning of stuttering and stammering in children may demand careful consideration. Boys are much more likely to be afflicted with this disorder than girls. Stuttering can be distinguished from stammering, although this distinction is often not made. According to Kussmaul, individual sounds are difficult for the stammerer, but not for the stutterer, with the latter the syllabic combinations offering the greatest obstacles. In stuttering a spasm accompanies the impeded utterance, but not in stammering; and greater nervous embarrassments underlie stuttering. Other differences are given by Kussmaul, but the one which is perhaps of the most practical importance in making a differential diagnosis is that stammering is often accompanied by anomalies of the tongue, lips, and articulating organs in general, while malformations, defects, paralysis, etc. are rarely observed in connection with stuttering. It is important for the practitioner to study the duration, possibility of improvement, and underlying causes of such defects when presented by young children. Usually stuttering does not show itself so as to attract attention before the age of six or seven, although rare cases have been observed in young children. Sometimes stuttering or stammering is a temporary affection, coming on in children who have been overworked or undernourished or both, who have been subjected to unusual strain or excitement, or who have had an attack of fever; and in the last case it may or may not be curable. Some forms of stuttering are distinctly hysterical, and may be relieved by attending to the general nervous health of the patient. The condition of the tongue and mouth of a little patient who has been attacked with a spasmodic chronic disturbance of speech should not be overlooked, as now and then some affection of the tongue, lips, and palate may be the cause of the difficulty. A spasm of the muscles of articulation and deglutition may cause an affection of speech that will simulate ordinary stuttering. Putting aside all these causes of temporary and, it may be, remedial forms of spasmodic utterance, the vast majority of cases will be found to depend upon some original defect in the central nervous apparatus. By prolonged and careful training a few of these cases can be cured, others can be helped, while a large percentage are absolutely beyond remedy.

Deformities and Defects in the Mouth and Pharynx.

Sometimes in children who are not mentally defective the palate, and even the jaws, may be of some particular shape, interfering to some extent with easy and perfect speech. The possibility of such cases should always be remembered, but, on the other hand, it should be clearly before the physician that

among the commonest somatic evidences of idiocy and imbecility are the shape and condition of the palate and jaws. In some types of congenital idiocy both upper and lower jaw may be narrow, the roof unusually vaulted or gothic, while in others the vault may be unusually low and flat. All varieties of palatal deformity or aberration are present in various types of idiocy. Teeth also are likely to be imperfect in such cases, and the tongue may be disobedient to the behests of the will. A fair judgment of the mental status of such a child and the meaning of its defective speech can often be reached by a study of these peculiarities and deformities of the head, face, mouth, tongue, teeth, jaw, and palate.

Mothers are always much inclined to regard a defect of speech in their children as due to what is popularly called tongue-tie. In rare cases a frænum which reaches too far forward may be present and cause some interference with the pronunciation of a few sounds; in still rarer cases the tongue itself may be congenitally short or deformed, but such conditions are easily determined or dismissed by careful examination.

Adenoid Growths.

Adenoid growths of the vault of the pharynx may be the cause of difficulties and peculiarities of speech, as well as of interference with hearing even to the extent of deafness. It will happen now and then that a child of two, three, or four years of age, supposed to be idiotic or imbecile, will in reality be suffering from adenoid deaf-mutism, the lack of mental development being apparently due to privation of two of the most important channels of communication with others. In all doubtful cases careful examination of the mouth should be made. Even if the deafness be not curable, great relief will be afforded to the parents by the knowledge that the child is not idiotic, and special efforts can be made at training and education in accordance with the principles and methods which bear the most fruit in dealing with deaf-mutes who are not primarily deficient in mind.

Various impediments in enunciation and pronunciation may also result from the peculiar obstruction produced by these papillomata when of large size. The voice is often considerably changed, and in enunciating certain letters muffling may occur; but hasty opinions should not be given as to the future simply because of the discovery of these growths, as they are sometimes present in idiotic children or in stammerers or stutterers.

Bad Habits of Speech.

In studying cases of imperfect or nervous utterance attention should be given to the subject of bad habits of speech. Children, through carelessness, through the foolish management of those around them, or of their own motion, may acquire certain habits of speech which will cling to them to such an extent as to become serious impediments in the way of development of good methods of speaking. Among these habits are frequently hesitating, unduly repeating, drawling or hurrying, using babyish or foolish expressions. Children should be coaxed or disciplined out of such habits when once acquired, but it is far better not to let them take possession of the child.

Treatment of Speech Defects.

The treatment of different forms of defective speech must depend upon the nature and degree. Aphasia from an acute lesion, such as hæmorrhage or

embolism, or as one of the effects of inherited syphilis, may often be benefited by time, medicine, and training. The medicinal treatment, after the first period of rest and care during the apoplectic stage, would be chiefly the use of absorbents and tonics, such as iodides, arsenic, iron, and strychnine. Diligent efforts should be made to train an aphasic child. Even some cases of congenital origin can under appropriate and persistent training be much improved. Here the diagnosis as to the presence or absence of true idiocy, and as to the degree of mental deficiency, is of great importance in deciding as to how far to push the treatment by efforts at education and training. In aphasia coming on gradually with more or less dementia in a child previously bright, or at least ordinarily intelligent, the probability of inherited syphilis should always be considered with the view of judiciously using iodide of potassium, iodide of iron, and similar remedies. The diagnosis of acquired deaf-mutism having been made, institutional or very careful individual treatment should at once be given. The oral system of educating deaf-mutes is particularly valuable for such patients, and much advance in the direction has been made in recent years. Great patience and skill are required even in acquired deaf-mutism. Some congenital cases improve, others make no advance, the former being cases in which the causes, whether prenatal or at the time of birth, have acted upon the organs of hearing or their encasements, and not upon the brain as a whole. It is said to be best to commence the instruction of congenital deaf-mutes at the age of about six years, but neglect of some training even before this age may at times be a great disadvantage. Practically, instruction should be begun as soon as it is possible to engage the attention of the child, but the amount of this instruction should be carefully considered. Where there are special impediments of speech, instruction directed to the relief of these may be successful. Of course all local surgical conditions should be carefully attended to, such as the rare cases of attached frænum, and those conditions which are more common, such as enlarged tonsils and naso-pharyngeal adenoids. Cleft palate and other forms of hard or soft palate must receive the attention of the surgeon and surgical mechanism. Stammering and stuttering can occasionally be greatly benefited by treatment, although in some cases all methods prove to be discouraging failures. The greatest attention should be paid to the maintenance of the best physical health, as by good food, careful hygiene, muscular and respiratory gymnastics. Systems of respiratory and vocal exercises are given in special works on the subject. Such treatment must necessarily be in the hands of one who has specially trained himself to carry it out.

IDIOCY AND IMBECILITY.

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Idiocy.—Three great classes of mental arrest or deficiency are known as *idiocy*, *imbecility*, and *cretinism*. Idiocy is an affection, either congenital or acquired in very early life, characterized by extreme mental deficiency, although it may be of varying grades of severity. Sometimes the idiot scarcely rises in brain power above the level of the lower animals, or he may be able to some extent to take care of himself, or again he may be capable of limited intellectual improvement. The mental deficiencies of idiocy, as a rule, go hand in hand with physical infirmity.

"The term idiocy," says Langdon Down (*Tuke's Diet. Psychol. Med.*), "has a very vague significance. It is associated in many minds with one type only of mental and physical condition, very often an imaginary type or one which rarely exists. It will be well to break down such contracted views and to efface the incorrect and distorted image. Looking around a large assemblage of children whose mental condition brings them under this generic term, it is very evident that they can be broken into well-marked groups, and that instructive life-pictures may be drawn of typical representations of this interesting class. Looked at *en masse*, they would give the impression of being heterogeneous to the last degree, but it will be found on closer investigation that it is possible to arrange them into groups with strong natural affinities among the constituents, and that in many cases a very remarkable family likeness may be traced."

The terms "imbecility" and "feeble-mindedness" may perhaps be regarded as nearly synonymous in common medical usage. Although between idiocy and imbecility no absolute line of demarcation can positively be drawn, a distinction is made for some practical purposes in clinical medicine and medical jurisprudence: but it is not correct to attempt to differentiate idiocy and imbecility by regarding the former as congenital and the latter as due to some cause acting after birth. Imbecility, like idiocy, may be congenital, developmental, or accidental, but true imbecility is nearly as often congenital as idiocy. Imbecility is therefore best defined as an affection congenital or acquired very early, and characterized by mental deficiency less in degree than idiocy. It must be distinguished from dementia, which in rare cases comes on in children who have been born with average capability and intelligence. Under congenital imbecility Clouston (*Clinical Lectures on Mental Diseases*) places cases which show every degree of mental deficiency, from the smallest amount of mental weakness down to idiocy. Such imbeciles may, according to this authority, have attacks of maniacal excitement or of melancholia; they may become dangerous and even homicidal; they may after an attack have secondary stupor, or may become demented as compared with their primitive condition; and they are often terrible masturbators. The clowns and fools of all ages would, as a rule, come under the head of imbeciles.

The medico-legal aspects and bearings of idiocy and imbecility should not be entirely neglected in general medical works, as not infrequently the family physician is the first to be called to give an opinion, which may have present or future importance, with reference to the mental status of the child under his care, although the more difficult and intricate problems associated with questions as to the mental capacity of the idiotic and feeble-minded are generally submitted for final decision to medical and legal experts. Ingenious efforts to frame legal definitions of idiocy which would stand the test of experience and practice have from time to time been made. The idiot, for example, has been designated by judicial authority as one who from his nativity by a perpetual infirmity is non compos mentis; or one who cannot count or number twenty pence, or tell who was his father or mother, or how old he is, so that it may appear that he hath no understanding of reason what shall be for his profit or what shall be for his loss; but if he have sufficient understanding to know and understand his letters, and to read by teaching or information, he is not an idiot. The defects and shortcomings of this ingenious definition are evident even to careless examination, and have often been indicated both in courts of law and by writers. The whole question of the legal relations and consequences of true idiocy can be dismissed with the assertion that if it has once been clearly established by competent mental and physical examination, it deprives the subject of the legal right and capability of performing acts which will stand in law and equity, and also relieves its subject from civil and criminal responsibility. It is simply a matter of careful determination in a given case. It is somewhat different, however, when the issue is that of imbecility or of backwardness.

The elder Seguin and others have erected a class of *backward children*, in whom functional torpidity or backwardness of the nervous apparatus is present, while not sufficiently abnormal to be classed as idiots or even imbeciles. These children are behindhand in mental development, and in some physical development is also retarded. They do not learn to creep or to walk until a much later period than others. Probably most of them could be classed, were it not for the sensitiveness of those to whom they belong, with the highest grades of imbeciles. Such children show a tendency to be behind their fellow-children in school and work, and even at play and in their sportive relations with other children. They become the butts and slaves of their better-equipped companions, by whom they are teased and hazed, and in various ways have their lives made a burden.

Moral Imbecility.—Moral imbecility is an affection sometimes classed under juvenile insanities as moral insanity; but a distinction can be made, although not with the same certainty as in the adult, between moral imbecility and moral insanity in the young. In some instances it would appear that perversion of the moral or affective life is brought about through injury, disease, or vicious habits in children who have been previously of a healthy moral and mental tone; but the subject of true moral imbecility is the victim of heredity; his condition is manifested as soon after birth as it is possible to clearly recognize by conduct deficiencies in the moral sense. Whatever views may be held as to the substrata of conscience and morals, it is convenient to use such terms as moral faculty and moral sense in their commonly understood significance. The moral sense covers that which causes a human being to weigh, consider, approve, or disapprove his own conduct; it includes that which in common language is called conscience. This faculty or sense, like others, should be regarded as a function or effect of organization, although one school contends for its separation from the physical man and would relegate it to some super-

natural sphere. I am not here particularly concerned with discussions of this kind, but as a physician, and in common with others who have seen much of nervous and mental disorder, I have become only too familiar with a class of cases which must be recognized as the subject of disease, and the mental care and treatment of which are forced upon us by every scientific and humane consideration. Maudsley speaks of cases of this kind as a group of persons of unsound mental temperament, "who are born with an entire absence of the moral sense, destitute even of the possibility of moral feeling; they are as truly insensible to the moral relations of life, as deficient in this regard, as a person color-blind is to certain colors, or as one who is without ear for music is to the finest harmonies of sound. Although there is usually combined with this absence of moral sensibility more or less weakness of mind, it does happen in some instances that there is a remarkably acute intellect of the cunning type." Such children are incorrigible to reproof and training. Punishment has no effect upon them, or will only be so heeded as to allow of their escape from immediate difficulty.

Much difference of opinion has arisen among authorities almost equally competent with reference to the exact nature of such cases. One contention is that such a thing as moral insanity or imbecility does not exist, and that close investigation will show in all alleged cases that intellectual disorder is present. It is held that we should not, even by a convenient label, separate these cases from others of accepted or acknowledged intellectual disorder. The difference is probably largely one of terms. In a well-studied class of cases the brunt of whatever defect or disease is present has fallen upon what every one regards as the moral nature of the individual. Recognizing morality and immorality as facts, no reason exists for not regarding these cases as instances of moral arrest or departure; it is as scientifically correct to do this as it is to subdivide the forms of insanity into intellectual, perceptional, emotional, and other well-known psychological varieties.

According to Herbert Spencer, higher feeling is merely the centre of co-ordination by which the less complex aggregations are brought under proper relations. In the process of evolution this centre of co-ordination may never be developed and moral imbecility may result, or great waywardness of moral conduct without marked disorder of intellect. The doctrines of moral imbecility and moral insanity are, then, as Tuke says, in full accord with the mental rules of evolution and dissolution laid down by Spencer.

Ray (*Medical Jurisprudence of Insanity*) gives numerous examples of moral imbecility, some of the most extraordinary character. One of these of historical interest is that of "Count Charolais, brother of the duke of Bourbon-Condé, whose sanguinary character has been commemorated by Lacretelle. He manifested an instinct of cruelty in the very sports of his childhood. He took pleasure in torturing animals and committing the most ferocious acts of violence against his domestics. He would stand at the window and shoot the artisans at work on neighboring buildings, merely for the pleasure of seeing them tumble from roofs and ladders. It is said he loved to stain even his debaucheries with blood, and committed many murders from no motives of interest or anger."

Works on medical jurisprudence and on mental diseases, and periodical literature connected with studies of this character, have furnished many illustrations of what is best classed as moral imbecility. Kerlin (*Med. News*, March 19, 1887) has presented short histories of four children—the first, illustrative of the incipient prostitute whose mental incapacity should be her protection; the second case, that of an incipient burglar; the third, a hereditary religious hyp-

ocrite and egotist, who, if not permanently sequestered, would fill a dramatic if not an awful rôle in crime; the fourth, a confirmed juvenile confidence-man.

Under the head of *idiots savants* has been described a class of idiots a few examples of which are to be found in almost every large institution. They exhibit in some special direction extraordinary or apparently extraordinary mental power. They may, for example, be extremely skilful in some simple handicraft; may have a wonderful ear for music or great skill in playing upon musical instruments; or they may show a remarkable faculty of making difficult calculations. They are usually instances of over-development in some one direction, the individual faculties in general being stunted and imperfect.

Varieties.—A thoroughly scientific classification of idiocy is in the present state of our knowledge impossible. Idiocy and imbecility may with reference to classification be briefly considered together. Kerlin (*Med. and Surg. Reporter*, May 20 and 27, 1882) has made a practically useful classification of these affections into idiocy, idio-imbecility, and imbecility, considering separately, as I shall also, forms of juvenile insanity which cannot properly be included under either idiocy or imbecility. Under idiots are placed groups of the lowest grades of intelligence and possible development; under imbeciles, those of low intelligence and development, but of higher grade than true idiocy and capable of various degrees of improvement; and under idio-imbeciles, those which form a connecting link between the others. Following Griesinger, the same authority divides idiots into the apathetic and the excitable, and imbeciles into a low, middle, and high grade. Various other attempts at classification have been made, but it would serve no good purpose to consider each of these in detail. All are more or less deficient, as standards of classification are commingled and confused. Some classes are founded upon teratological and others upon pathological data; some upon ethnological and others upon anatomical, etiological, psychological, or other features. The best classification eventually will be one based upon a study of groups of clinical phenomena which can be readily referred to teratological and pathological conditions.

A useful general classification of idiocy is one suggested by Langdon Down (*Tuke's Dict. Psychol. Med.*) into congenital, developmental, and accidental. Congenital idiots are born deficient as the result of causes usually unknown, except that bad heredity is commonly present; and the majority of cases of true idiocy belong to this class, although some authorities improperly exclude from it cases whose pathology seems evident, as porencephalic, hydrocephalic, and microcephalic cases.

Congenital idiocy is usually recognized at an early period, within a few months or even a few weeks after birth, although in exceptional instances it is overlooked until the child has reached a year or more.

Developmental idiocy receives its name from the fact that it originates at certain developmental epochs, as at first or second dentition, or perhaps at the beginning of puberty, typical cases being up to a certain age normal and of good, or at least ordinary, physical health. Following a convulsion or a series of spasms, the child may show a marked intellectual change and variation of character, or this deterioration may come on gradually, without any history of spasm or any abrupt attack, in children perfectly normal as to intelligence up to the age of eighteen months or five, six, or even seven years, or perhaps nearly or quite to the age of puberty. In some of the cases which have been reported the mother has been acted upon by malign or depressing influences or has been the subject of disease or deprivation of some kind during pregnancy. Down has advanced the reasonable supposition that, according to the period of embryonic life at which the causative impression is made upon the mother, may

be the time of development of the manifestations of idiocy; occurring at an early period, such disturbances result in congenital idiocy.

Accidental idiocy is a form of mental arrest which is caused, as its name indicates, by some accident at or after birth. In not a few such cases the predisposition to mental weakness may have existed, but even in these it might not have shown itself in so marked a manner or at all. Hæmorrhage or depressed fracture or abscess from aural disease may have been present, and meningitis of either the hard or the soft membranes is sometimes found post-mortem. While recognizing these three etiological varieties as of great importance and value for purposes of study, one cannot get a clear idea of the types of idiocy without a different subdivision, as under the congenital, developmental, and accidental classes idiots differing widely in appearance and in their mental and physical possessions are found, although the differences are greater in congenital idiocy than in the other forms.

Down has also proposed a more elaborate and differentiated classification, giving many different forms, and arranging these into more than twenty subclasses under the general heads already considered. He has paid particular attention to ethnological features, describing such varieties as the Caucasian, Ethiopian, Calmuck or Mongolian, Malayan, and Negroid. The patients bear a real or fancied resemblance, particularly in face and head, to individuals of the different races indicated by the names. The Calmuck or Mongolian appears to be the most clearly recognizable of these varieties. Among its characteristics are short stature, deficiency of the posterior part of the head, sparse hair, obliquely-placed and widely-separated eyes, and depressed nose. Mongolian idiots are grotesque, seeing the humorous side of things; they are all characterized by strong self-will and wonderful imitative power, and they have other physical and mental peculiarities to which our space will not permit us to refer.

Among other varieties of idiocy recognized by Down, Shuttleworth, and others are those the names of which are based upon peculiarities in the size and shape of the head; but this method of classification, like that based upon ethnological marks, is not capable of being carried out over the entire range of cases. Different shapes of head are found in cases of idiocy with the same or similar mental and physical features, or, on the other hand, either different or the same or similar symptoms, syndromes, or conditions are presented by idiots with heads unlike in shape and size. It is true, nevertheless, that some of the varieties present more or less common features, and the terms used are at least convenient for the purpose of investigation and record. Macrocephalic idiocy in such a classification might describe cases due to hydrocephalus or to hypertrophy of the bone or intracranial structures, or to both. Microcephalic is a term applied to idiots with very small heads, technically to those whose heads are less than seventeen inches in circumference; hydrocephalic idiocy is the result or accompaniment of hydrocephalus; brachycephalic means broad and short-headed, and dolichocephalic long-headed—long in proportion to breadth. The term cephalic index is applied to the breadth of the skull multiplied by 100 and divided by its length, and if above 80 the skull is called brachycephalic. In plagiocephalic idiots the skull is out of shape, so that the features lie in an oblique plane; scaphocephalic, from a word meaning the hull of a ship, is a term applied to that form of idiocy in which the head is shaped like the keel of a boat turned upside down.

Ireland, the author of a well-known text book on idiocy and imbecility (*Idiocy and Imbecility*, London, 1887), has proposed a classification which has been much followed and has much to commend it, but it is by no means suffi-

cient to cover all cases. It is a mixed classification, based on pathological, etiological, and semiological features, and has ten classes, as follows: 1, Genetous; 2, Microcephalic; 3, Eclamptic; 4, Epileptic; 5, Hydrocephalic; 6, Paralytic; 7, Cretinism; 8, Traumatic; 9, Inflammatory; 10, Idiocy by deprivation.

The term "genetous idiocy," as used by Ireland, practically means the same as congenital, but other varieties in his classification are just as truly genetous or congenital. Eclamptic and epileptic idiocy are two varieties, in both of which spasm or convulsion plays a prominent part, but in the eclamptic occurs soon after birth, and is supposed to be due to convulsive seizures, these not infrequently stopping, but leaving the mind permanently affected and arrested; while in epileptic idiocy the convulsion and the idiocy may both come on at different ages, and the epilepsy remain as a permanent accompaniment of the idiocy. According to Brush (*Keating's Cycl. Dis. Children*, vol. iv.), an epileptic idiot is one whose mental growth has been arrested by the occurrence of epilepsy in infancy or childhood. From this point of view epileptic idiocy would belong to the etiological variety, while eclampsic might or might not. Microcephalic and hydrocephalic have been already discussed. Paralytic idiots have forms of monoplegia, hemiplegia, paraplegia, and diplegia, as described in this work by Peterson. Very commonly the paralysis is of the spastic variety. Various forms of idiocy might be classed under traumatic. Not a few cases are supposed to result from injuries inflicted during prolonged labor by bruising and squeezing of the child or by instruments in assisting at its delivery. Some, but by no means the majority, of paralytic cases are attributable to traumatism; many are dependent upon sclerosis, arrest of development, neoplasms, meningitis, meningo-cerebritis, or cerebritis, and the pathological process may occur either before or soon after birth. Of course inflammation may be set up by traumatism, when the case might be regarded as either traumatic or inflammatory. Hydrocephalus is sometimes the result of a tubercular or other inflammation of the membranes or ependyma of the ventricle. Confirmed idiocy and forms of juvenile insanity occasionally occur during or after the infectious febrile affections of infancy or early childhood, such as cerebro-spinal fever, scarlet fever, measles, whooping-cough, diphtheria, etc., and these are either toxic or inflammatory affections, or both. Sensorial idiocy, or idiocy by deprivation, is the result of the lack or the loss of important senses like sight or hearing. Some, but by no means many, of these cases may by careful education and training be lifted out of this idiotic state; in others the loss of hearing, of sight, or of other senses may, like the mental defects in general, be dependent upon embryonal arrest. Sensorial idiocy and imbecility, therefore, need to be subdivided into at least the two varieties of congenital and acquired or accidental. It may be of great practical importance to be able to decide to which of these two varieties a case belongs. Cretinism will be treated of in a separate article.

Shuttleworth's classification (*British Med. Jour.*, Jan. 30, 1886), which includes the varieties of Ireland with some additional classes, is as follows:

"Class A—Congenital.—1, Microcephalic; 2, Hydrocephalic (also non-congenital); 3, Scrofulous (Mongol type); 4, Sensorial (also non-congenital); 5, Primarily neurotic; 6, Paralytic (also non-congenital); 7, Choreic (also non-congenital); 8, Cretinoid; (*a*) sporadic, (*b*) endemic. Class B—Non-congenital.—*a*, *Developmental.*—9, Eclamptic; 10. Epileptic; 11, Syphilitic; 12, Post-febrile (also accidental); *b*, *Accidental or Acquired.*—13, Toxic; 14, Traumatic; 15, Emotional; 16, From mixed causes."

Strumous or scrofulous forms of idiocy can be clearly placed to the strumous

PLATE XVII.









FIG. 1. Congenital Idiot of Low Grade.
FIG. 2. Epileptic Imbecile.
FIG. 3. Insane Imbecile.
FIG. 4. Congenital Idiot of Low Grade.

or scrofulous diathesis; they belong to the congenital class. The primarily neurotic are those with bodies comparatively well developed and with signs of irregular nervous action.

The term "choreic," as applied to idiocy, has been used in several ways —as descriptive of the motor phenomena presented by the patient; or of idiocy resulting in a child born of a mother choreic during pregnancy; or of cases in which violent or persistent chorea seems to induce idiocy in the developing child.

Congenital idiocy due to inherited syphilis is probably but not certainly rarer than a form of juvenile dementia, which usually develops some years after birth, and is described in another section. Some syphilitic children are idiotic from birth, and in these cases treatment is generally as useless as in cases due to other causes, while in syphilitic juvenile dementia specific treatment may be very efficient. Shuttleworth applies the term "toxic idiocy" to idiots who without bodily deformity suffer from malnutrition of the brain, which he supposes to be due to some unknown toxic influence. Emotional or excitable idiocy is that which shows shrinking, fear, apprehension, excitement as its chief features.

Etiology.—A bad heritage is the great predisposing cause of idiocy. The idiot's ancestor may not have been insane, imbecile, or idiotic, but in the majority of cases some constitutional taint or tendency, as syphilis, struma, or tuberculosis; some toxic affection, as alcoholism; some form of mental disease or defect; some neurosis as epilepsy, hysteria, neuralgia, or neurasthenia, or some organic disease of the brain, as meningitis, sclerosis, softening, or hæmorrhage, will with sufficient investigation be found to have been present in near or remote progenitors. Intemperance, alone or combined with other causes, such as epilepsy or insanity, has been shown by reliable statistics to be one of the commonest predisposing causes. Far too frequently imbeciles of high, or in some cases of comparatively low grade, marry, with degenerate offspring as the result. Numerous studies of heredity in connection with this question of the causation of idiocy have been made. According to Shuttleworth and Beach (*Tuke's Dict. Psychol. Med.*), the most frequent combination of two causes of insanity is that of insanity with epilepsy. Even deaf-mutism, with perhaps in most cases the addition of some other lowering agency, has resulted in idiocy and imbecility in the second and third generation. By the authors above quoted syphilis was found certainly to be the predisposing cause in 17 per cent. of more than two thousand cases. Good authorities place 2 per cent. as covering the cases of syphilitic idiocy, although others would put it much higher. The question of consanguineous marriages has been much discussed in connection with the causation of both insanity and idiocy, and authorities are somewhat at variance; but it may be regarded as certain that the marriage of relatives in one or both of whom mental or neurotic defects or constitutional or toxic conditions are present will predispose to idiocy and imbecility as to other degenerative diseases. It is better, as a rule, that relatives should not intermarry, as few stocks are absolutely without taint or weakness.

Bad health in the mother and impressions made on her during pregnancy, the father's health or condition at the time of procreation, age or premature senility of parents, and acute diseases during pregnancy,—all have some etiological importance.

Among causes acting at the time of birth are prolonged and difficult labor in mothers with small or deformed pelves; injuries by instruments or other manipulations or by the umbilical cord, and suspended animation from whatever cause. The use of instruments is, however, a much less frequent

cause of idiocy, infantile paralysis, and convulsions than is commonly supposed. They are often used after the injury has been done by long-continued pressure. The prompt and skilful use of forceps sometimes saves life and health for both mother and child, oftener than the reverse. In these pressure and forceps cases skull depressions and hæmorrhages sometimes occur. The causes acting after birth are comparatively few, but among these are injuries from falls or blows, convulsions of unknown origin, fright, febrile diseases, and in rare cases the ingestion of toxic substances.

Symptoms.—To briefly give the symptomatology of idiocy in general is an almost impossible task. The signs and symptoms will vary widely with classes, and to a certain extent, in considering the varieties of idiocy, I have already described its symptomatology; but certain physical and mental characteristics belong to almost any form of idiocy, and from studying these the practitioner of medicine, even without special knowledge of the subject, may be able to come to a conclusion as to the nature of such a case at an early period. Much can be learned as to the physical features of idiocy by mere inspection, and much more by careful and detailed investigation. The size and shape of the head and face and defects of feature may prove serviceable in coming to a decision. I have already spoken of varieties dependent on the shape of the head to which special names have been given, as microcephalic, and brachycephalic. Unusual smallness or largeness of the head, or, what is more common, deformity or asymmetry in its shape, is often the first to attract attention. In some types of idiocy, as the Mongolian, a remarkable deficiency of the posterior part of the cranium is often observed; in others it may be that one side of the head, or even one special region of the cranium, will show marked depression or arrest. In almost every instance of true idiocy some peculiarity of face or feature is present: this may be abnormal position or separation of the eyes; deformity, unusual size, or peculiar implantation of the external ear; depression or flattening of the nose, or general asymmetry of the face. The oral cavity of idiots has been the subject of much investigation, and great varieties in the shape of the mouth and pharynx are found; it is high and gothic; or low and flat; or irregular; or a cleft or partially cleft palate is present; and sometimes the entire buccal and pharyngeal cavities are contracted as well as irregular in shape. The greatest possible variations in the shape, size, and implantation of the teeth are to be observed: they are notched or pegged or serrated; they overlap and are irregularly crowded: frequently they decay at an early period. The jaws may be too narrow or may fail to be properly apposed to each other; occasionally, instead of being small, the lower jaw is prognathian—of unusual size and projection. The tongue may be too large, or even too small, and frequently refuses to obey the behests of the will. The head cannot be held erect or is carried badly.

The control which the patient has over ocular movements and facial expression is often of great value to the diagnostician. Strabismus is common, and this may be of one eye or both, or of an alternating or varying type. Of other simple tangible phenomena, drooling or slavering is an important manifestation. Inability to stand or walk at the usual age may lead to suspicion as to the true condition, and even if the child can walk his carriage and gait may be very significant. Some idiots stoop, some have a lopsided method of progression; many are slouching in station and in walk; some run when they should walk, or walk when they should run; the gait is often ataxic or incoördinate, or, rather than this in a technical sense, it may be simply maladroit or awkward. The hands and arms are not used with the same precision, accuracy, and adaptation of means to ends as by other children.

Below the head and neck defects and peculiarities may be as various as above. Curvatures and twistings of the trunk, asymmetry in the development of the legs and arms; flexures, curvatures, or other deformities of the limbs; knock-knees or bow-legs or parrot-toes, and numerous other deformities, malpositions and arrests, may be present. According to the variety of idiocy there may be paralysis, with or without local spasm or contracture, in limbs or face; sometimes this is one-sided—that is, monoplegic or hemiplegic; sometimes both legs, or both legs and one arm, or all four limbs, may be involved in the paretico-spastic condition.

The skin may be harsh or dry or coarse; it may show evidences of impaired or imperfect circulation in coldness or duskiness of the extremities, in blotches or discolorations, or even in a tendency to trophic affections, such as ulcerations and eruptions. Not seldom the hair is scanty or coarse or badly nourished, and the nails may be of bad shape or abnormal in appearance. The sexual organs may show unusual smallness or deformity or peculiarity of some kind.

Speech may show many varieties of defect and aberration, and these have to some extent been considered in another section. The incapacity to attend to what is said or what should be done is one of the first things to attract attention to an idiotic child. At an age when infants and small children ordinarily attend to many matters of passing interest, such a child cannot be made to fix its attention even by the most strenuous efforts; indeed, a close study of this faculty will perhaps throw more light than anything else upon the degree of mental development in children. Self-will, undue emotionality, lack of ordinary obedience, impetuous and unreasonable behavior, inattention to natural wants and demands, are all points of importance in the mental investigation of supposed idiocy.

While some or many of the physical peculiarities enumerated may be present in cases of idiocy, it must not be forgotten that in some types at least they are nearly all wanting. In the so-called accidental idiocy, for example—that which has resulted from injury at the time of or after birth—there may be a striking absence of the usual physical defects and deviations. Such children are sometimes scarcely to be distinguished in head, face, form, attitude, or movements from those retaining their mental faculties, although the traumatism may have left its mark in depressed skull or paralytic or spastic limbs.

Pathology.—Many facts with reference to the pathology of idiocy will be found discussed under such heads as the cerebral paralyses of childhood, hydrocephalus, brain atrophy or hypertrophy, porencephaly, sclerosis, cortical arrest, cysts, softening, hæmorrhage, embolism, thrombosis, chronic meningitis, meningo-encephalitis, and encephalitis; while many of the symptoms peculiar to idiocy have been or will be considered under such headings as speech defects and anomalies, nystagmus, athetosis and athetoid affections, and epilepsy.

Idiocy has no fixed pathology, but numerous exceedingly interesting pathological appearances and conditions have been reported, as anæmia and hyperæmia of the brain; hypertrophy and atrophy, general and partial; softening, usually local; sclerosis of various forms; hydrocephalus and porencephalus, meningitis, and tumors; thickening of the arteries; thrombosis of the sinuses; asymmetry or unusual simplicity of the hemispheres and convolutions; alterations in the relative amount of white and gray matter of the brain. Disease of other organs than the cerebrum is often associated with cerebral disease, as, for example, atrophy, tumors, and cysts of the cerebellum, or spinal affections,

such as poliomyelitis; congenital arrest of development of the pyramidal tracts; descending sclerosis; chronic myelitis; or pseudo-hypertrophic paralysis.

Wilmarth (*Alienist and Neurologist*, October, 1890), has given the results of the study of one hundred brains, and his condensed statement presents in an unusually interesting and practical form the pathology of most cases of idiocy. I had the opportunity of studying some of the brains and skulls which are included in this list of cases. Sclerosis with atrophy, 12; scleroso-tubereuse, 6; diffuse sclerotic change, 7; degenerative changes in vessels, ganglionic cells, or medullary substance, not constituting the true sclerosis, 15; hydrocephalus, 5; general cerebral atrophy, 2; non-development in various forms, 16; infantile hæmorrhages, 1; extensive adhesions of membranes from old meningitis, 3; angeiomatous condition of the cerebral vessels (with degenerative changes), 1; glioma (with sclerosis), 1; porencephalus, 1; and 31 cases where actual disease or imperfect development of the brain proper was not demonstrated; there was hypertrophy of the skull, 6; acute softening (recent), 2; demi-microcephalic, 2; 1 brain was above the usual weight, but the convolutions were large and very simple in their arrangement.

In 75 cases, or in all in which injections of chloride of zinc or extensive destruction had not made weighing valueless, the brain was carefully weighed. The average weight was 38.3 ounces; in 14 cases the weight was below 30 ounces; thickening of the skull to an extent to constitute hypertrophy was found in 8 instances; while in 8 the skull was unusually thin, not including cases in which there was distention from hydrocephalus.

An attempt at a pathological classification of idiocy might be made, although this undoubtedly would contain many imperfections. The classes will be sometimes found to blend and commingle, cases will repeat themselves under different headings, and other objections will appear; but, on the whole, such a classification will indicate in a general way the groups as they would be found in any large institution.

The most important of these classes are as follows:

1. Idiocy due to gross organic lesions, the history of which can be determined with more or less accuracy—lesions such as hæmorrhage, embolism, thrombosis, tumors, meningitis, meningo-encephalitis, and encephalitis.

2. Idiocy due to various forms of sclerosis, as the diffuse, multiple, or disseminated; sclerosis with atrophy, and lobar or tuberous sclerosis.

3. Idiocy due to arrest of cortical development, a true *agenesis corticalis*, or absence of normal cells, which has been well studied and described by Sachs of New York (*Jour. Nerv. and Ment. Dis.*, August, 1892).

4. Idiocy due to large cerebral deficiencies, but sometimes originating in hæmorrhage, thrombosis, embolism, sclerosis, meningitis, etc.—such conditions as general atrophy or hypertrophy, porencephalus, and hydrocephalus.

5. Idiocy due to inherited or congenital syphilis, which perhaps might be included under some other subdivision, but the cases are supposed by some authorities to have a peculiar history and special appearances, and therefore may be placed for practical purposes in a separate group.

6. Idiocy of toxic origin, under which head would be included cases resulting from acute poisoning or following infectious diseases, such as measles, scarlet fever, etc.

Diagnosis.—The diagnosis of idiocy will only be difficult in early infancy and in a few rare cases. The facts to be learned by observing whether or not the child pursues a regular, or at least an average, method of development have already been considered with reference to the sense of hearing, the

acquirement of speech, and the development of ideas, when discussing anomalies and defects of speech. Different children of the same family or healthy children who are known to the physician can be compared with the one alleged to be idiotic. Careful consideration must be given to the question of normal retardation or mere backwardness, or the existence of a true insanity, such as syphilitic dementia. The diagnosis of idiocy and imbecility is always most assisted by a careful study of the physical conditions presented by the child—the shape and size of the head, which have already been discussed; the condition of the eyes and the ocular muscles; the appearance of the palate, jaw, and tongue; the presence or absence of drooling; ataxic, athetoid, or choreic movements; peculiarities of expression; deformities of the ear, nose, or mouth; ungainly, limping gait; paralysis or contractures, or both in the same case. The more marked and numerous these arrests and aberrations of bodily development, the more likely it will be that the diagnosis of idiocy is correct. In every part of this article mental disturbances and deficiencies are under consideration, and it is only necessary to say here that such faculties as attention, memory, and inhibition should be particularly studied.

Prognosis.—The prognosis of idiocy as to cure is of course altogether bad, but it should be remembered that improvement can be made in the condition of idiots even of comparatively low grade. They can be made more comfortable, happier, less offensive, less destructive, and even, in a limited number of cases, more useful, by care, discipline, education, training, and, to a limited degree, by the use of nutrient and medicinal agencies.

"During the fifty years over which efforts for the amelioration of the imbecile have extended," says Shuttleworth (*Tuke's Dict. Psych. Med.*), "the sanguine prognostications of early enthusiasts may not have been realized, but nevertheless a large percentage of benefit has been recorded. An imbecile, however well trained, will always need some kindly aid and consideration from those with whom he is associated. It is not to be expected he will be able to manage his own affairs or compete in the labor-markets of the world. Placed in a niche, however, where he can without molestation exercise his acquired talents, he will in many cases turn out more or less remunerative work; and, failing this, he will, in consequence of having some resources within himself, cease to be a nuisance to his friends. Even the improvement of habits by systematic training is not to be despised in relation to the comfort of the family; and it must be borne in mind that the idiot left untrained is sure to deteriorate. A review of twenty years' experience at one of the large English institutions furnishes the following results: Of patients discharged after full training, 10 per cent. are self-supporting, whilst another 10 per cent. would be so if they had obtained suitable positions, and about 20 per cent. were reported as useful to their friends at home."

Treatment.—In considering treatment the subject might be variously subdivided, as into prophylactic and direct; into hygienic, educational, gymnastic, and medicinal; into measures for the affection itself, and for diseases and conditions that are intercurrent or resultant. Habitation, diet, and clothing should be carefully selected; and in doing this particular attention should be paid to the variety of idiocy and to the diathesis from which it may have resulted. The ventilation of rooms at night and proper beds and clothing should receive attention. Cleanliness must be enforced by bathing, which can also be used as an invigorating and strengthening measure. All idiots should have exercise graded to their physical condition and powers; mistakes may be made in attempting to do too much in this direction or by not duly considering their differences from other children. Systematized gymnastic exercises or calis-

thenics can be used with great advantage, both for physical development and to a limited extent to promote mental power, and to a larger degree to add to the happiness of these defective children.

Whether or not an idiotic child should be removed from its home to an institution is a question that the physician must frequently meet, and in general terms it may be said that a well-conducted institution, as a rule, is the best place, both for him and for other members of the family. The danger of being made worse by contact with others—an argument which is so often used against sending a patient to an insane hospital, and occasionally with force—does not apply, or to an exceedingly limited extent. In institutions of large size the defective children can be so classified that their training can be carried out systematically and without much jarring and strain, or, if incapable of any improvement, so that they can be cared for and their happiness promoted in the best possible manner. The presence of an idiot in a family is often painful and deteriorating both to parents and to other children. Home treatment may be pursued where parents have large means and the care and training of an idiotic child can be managed apart from the rest of the family. For the wealthier classes the institutions which take only a small number of children, if these are conducted on thoroughly scientific as well as humane principles, offer some advantages. Amusements, exercises, and social intercourse are all regulated to excellent purpose in institutions like those at Elwyn, Pennsylvania, at Vineland, New Jersey, and at Barre, Massachusetts.

The educational treatment or training of the feeble-minded has received much attention in recent years. In 1801 the first great incentive was given by Itard to this method of bettering the condition of the idiotic by his interesting account of his own experiences with a child that had been found savage in the woods, but to the elder Seguin (*Idiocy and Its Treatment by the Physiological Method*, 1866), the greatest of credit is due. He was truly the first apostle of the idiot. Volumes have been devoted to this most interesting subject, but to these I can scarcely do more than refer. This training and education should be patiently directed to the development of the deficient senses; to the training of the hands and feet; to the improvement of carriage and gait; to stimulating the slow and to braking the morbidly active; to the development and improvement of speech; to arousing attention, imitation, imagination, comparison and judgment; and to the awakening and cultivation of the moral senses and power of control.

Not much can be said about the medical and surgical treatment of idiocy. Attention should first be directed to the probability of the idiocy being due to such possibly remedial causes as inherited syphilis or traumatisms. The iodides of potassium and sodium, hydriodic acid, and various mercurial preparations may be tried in cases presumably due to inherited syphilis, but too much must not be expected, as syphilis in the progenitor has established a condition of arrest rather than an active and removable lesion. It is different in infantile and juvenile dementia due to syphilis, which have been treated of in another article; here the treatment may promise much, and, as the differentiation is sometimes difficult, it may sometimes be employed as a diagnostic measure. Everything should be done to promote the nutrition of the idiot—malt, maltine, cod-liver oil, and nourishing food for the strumous; the same with preparations of iodine, arsenic, and tonics in general for the rachitic; digestants like pepsin, pancreatin, the mineral acids, and stomachics for those of weak digestion; astringents, antifermentatives, and intestinal tonics for those afflicted with diarrhœas and dysenteries; lime-juice, vegetable acids, bitters, quinine, iron, and fresh food for the scorbutic; ointments for the skin, washes for the mouth,

lotions for the eyes,—but these will not be to the working of a cure, but to the relief of annoying and depressing symptoms and conditions. For convulsions, bromides, chloral, sulphonal, antipyrine, and similar inhibitors of cortical excitability, guarded by arsenic and supported by nutrients, may be administered. For excitement trional and tetronal have been found valuable.

What to do with backward children is often a serious problem. They certainly should not be sent to the institutions for the idiotic and feeble-minded, nor can they always with advantage be kept at schools of ordinary or high grade. When their parents can afford the expense, it is best, for a time at least, to have them instructed by tutors or to send them to small schools, with the understanding that special attention shall be paid to them, and that their instruction shall be regulated as far as possible in accordance with their needs and capabilities. The physician should be careful not to be too hasty in his prognosis or prophecies in reference to such children. A practical point worth while to be always borne in mind is that sometimes mental backwardness, like physical backwardness or peculiarity, is due to the rachitic diathesis. Just as in well-defined types of rachitic pseudo-paralysis, the bony and other forms of arrest or deformity will yield to an abundance of good air, good food, and treatment with such preparations as cod-liver oil, arsenic, iron, and iodides in various forms, so some cases of intellectual slowness and torpor will be greatly improved or cured by similar measures.

For evident cranial depression and fracture trephining may be resorted to, though in long-standing cases the outcome is generally doubtful. The surgical treatment of idiocy has recently received an impetus through the operations performed first in France by Lannelongue (*L' Union Médicale*, July 8, 1890), in England by Horsley (*Brit. Med. Jour.*, September 12, 1891), and in this country by Keen (*Med. News*, Nov. 29, 1890, and *Amer. Jour. Med. Sci.*, June, 1891), and others. At the French Surgical Congress in 1891 twenty-eight cases of craniectomy were reported, with but one death, and considerable improvement was claimed in some of the cases, but a careful reading of the reports of cases shows that the real benefit has not been great.

The best method of training moral imbecility must be sometimes considered. In most genuine cases, education or philanthropy, kindness or cruelty, the sugar-plum or the whip, the Sunday-school or the reformatory, the asylum or the penitentiary, will equally fail; or perhaps I should not say equally, as in a few instances some strengthening of the weak and imperfect coördinating centres may be possible. To the typical case, to the vast majority of cases that would come under this designation, belongs the term incorrigible. Some of the most practical and most experienced authorities, as Tuke and Kerlin, believe that education in its ordinary meaning should be largely withheld from this class. The former says of them: "The early detection of these cases is not difficult: they should be subjects for life-long detention; their existence can be made happy and useful, and they will train into comparative facility and harmlessness if kept under a uniform, temperate, and positive restriction. The school-room fosters the ill we would cure: in teaching them to write we give them an illimitable power of mischief; in educating them at all, except to physical work, we are adding to their armament of deception and misdemeanor." As Kerlin puts it, we should refuse them the ordinary routine of education, because "we believe that in educating moral imbecility we are training experts for the later rôle of so-called moral insanity."

CRETINISM.

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Cretinism is a form of arrested physical and mental development, chronic and usually endemic, characterized by peculiar appearances and malformations, but especially by smallness of stature, distortion or deformity of the face, head, and body, unhealthiness of the skin, enlargement or absence of the thyroid gland, or fatty growths above the clavicle. The derivation of the word "cretin" is involved in curious uncertainty. Its origin has been assigned, for example, to *creta*, chalk; to *cretira*, stupid, silly; and to *Chrétien*, Christian, because cretins are supposed to be as happy as Christians ought to be. In different regions and by different writers cretins have been called by various names, as *cagots;* but the cagots are not true cretins, but a proscribed people living in Bearn and Gascony who may at one time have suffered from a form of leprosy. In Germany cretins are called *Kreidlings* and *Kretins;* in Austria, *Gacken* and *Trotteln;* in Italy, *Gavas*, *Totolas*, *Cristiani;* and in South America, *Bovos* and *Tontos* (Tuke).

Cretinism is endemic in various countries, but nearly always in mountainous regions, as in the Pyrenees and Alps, in the Highlands of Scotland, and in the Himalayas. In this country a few cases are occasionally found together, as in the mountains of Vermont and California, but the affection is chiefly of interest to American physicians as a sporadic disease. Probably it is found to some degree all over the world. In a few countries in which it is most prevalent, as in Switzerland, France, Italy, and Spain, it often shows a curious tendency to limit itself to particular spots, even in a region of the same general climatic and geological features—to blight one valley or village, while another close by, and apparently not different in environment, escapes. While pronounced cretinism is rare in this country, cretinoid cases are seen with more frequency; and by cretinoid cases, in this connection, I do not refer to ordinary cases of myxœdema, although Sir William Gull described myxœdema under this term, but rather to cases which I now and then see in which neither myxœdema nor true cretinism is present, but in which the patient in face, head, expression, stature, skin, mental capacity, or other points reminds one of the cretin.

Symptoms.—The symptomatology of cretinism and cretinoid disease can perhaps be best presented by first describing one or two cases. One recently studied by me at the New Jersey Home for the Feeble-minded, a girl aged nine years, was the seventh child, born after difficult labor, but seemed strong until she was sixteen or eighteen months old, and until this time was bright and active and did not seem defective. At this time she had a severe fall. Her mother was a hard-working woman; the father had rheumatism and was unable to work, and at times was a hard drinker. She had one brother

and three sisters living and healthy. She was a well-marked cretinoid case, with flat face and open mouth, the tongue filling it, but not protruding. She had a soft, but not large, swelling above each clavicle. Her mental condition was very low. She never gave a direct answer to any question, and had no words at her command; but she knew her own name, could feed herself, and could walk a short distance with assistance. She was almost as broad as she was long. I have seen a fair number of such cases of cretinoid idiocy, but generally of much higher grade, in private and hospital practice and in the institutions for the feeble-minded both at Elwyn, Pa., and at Vineland, N. J.

In the nervous wards of the Philadelphia Hospital is a typical example of sporadic cretinism, which I have frequently studied and discussed before my classes. Recently a description of this case has been published by Lloyd (*International Clinics*, 1892). The cretin is thirty-two years old, and was born in the outskirts of Philadelphia. He has a myxœdematous face with large lips and hypertrophied, protruding tongue; small limbs, even as compared with his body; protuberant belly; the sexual apparatus of a small child; no hair about the pubes or on the face, and a scanty supply on the head; bad teeth and gums; eyelids red, tumid, and nearly closed; the skin yellowish-white and dry, and sweating only on the forehead and forearms. His height is 35½ inches. He can walk a little, but is very weak on his limbs. Knee-jerks and the reflexes are normal; sensation seems to be everywhere preserved, and sight and hearing likewise appear to be good. The thyroid gland is wanting, but above the clavicles on each side is a soft mass, probably a fatty growth. While his mental capacity is very low, it is more than his appearance and lack of speech, which is confined to a few words, would indicate. He is observant of much that goes on in the wards, understands much that is said to him, recognizes physicians and old friends, and is appreciative of favors. He has lived along with scarcely any change during the many years that he has been in the hospital, escaping intercurrent disease. Lloyd gives the following measurements of his head and limbs:

	Height	35.5	inches.
Head:	Fronto-occipital diameter	7.5	"
	Bitemporal	5.5	"
	Biparietal	5.5	"
	Circumference	22.25	"
	From ear to ear	12.25	"
	From root of nose to occip. protuberance	13.25	"
Limbs:	From ant. sup. spine of the il. to inner mal.	14.5	"
	Length of femur	7.	"
	Length of humerus	5.5	"
	Length of radius	5.5	"

His temperature is almost constantly subnormal, and during one week in which it was carefully taken, he being in his usual health, it never reached the normal but once, and most of the time ranged below 97.4° F. (The plate representing this case, is from Lloyd's paper.)

For many years in the neighborhood of the hospital was another example of typical sporadic cretinism, presenting most of the features of the case just described.

In describing the above case I have practically given the symptomatology of cretinism. The word *stunted* describes the conditions, physical and mental, better than any other. The cretin is small in stature except in very rare

cases; thus Lombroso has described a family of cretins of unusual stature. The head is frequently contracted from the front backward or in some way is asymmetrical. In typical cases the features are striking—short, flattened nose; eyes wide apart; puffy, drooping lids; small face and protruding tongue. Not only temperature, but pulse and respiration, and all the vital processes, are sluggish; digestion, secretion, and excretion go on torpidly; menstruation is established late or not at all.

Speech varies much in different cases, and efforts have been made to classify cretins with reference to their possession of this faculty, the lowest grade consisting of those who are deprived entirely of language or have so little as to amount to nothing. Cretins of this class lead little more than a vegetative life, and are not capable of being improved much by education, training, or change of environment. By a study both of their speech and of their mental deficiencies in general they are sometimes placed in two higher classes than the one just described. In one the cretins have some language which is capable of being extended; they improve somewhat by imitation; they have limited powers of reproduction, but they have little spontaneity or real intelligence, and generally their efforts are confined to matters absolutely necessary to their existence and comfort. A higher class of semi-cretins often possess a fair amount of physical and mental development. They can take care of families, which, unfortunately, they sometimes have, and they are capable of considerable intellectual improvement; in a few cases, indeed, they have so little the characteristics of true cretinism that they are only to be recognized as belonging to these people by one or two peculiarities.

A peculiar class of cases of fœtal or congenital rachitis has been observed, the children being born with deformed bones, beaded ribs, etc., the bones in some cases being soft. By some the terms infantile osteomalacia and cretinism have been applied to these cases, chiefly because they have failed to present the macroscopic and microscopic appearances of rachitis. They have been described by Bode, Barlow, and Marshall of Preston, who are referred to by Ashby and Wright.

Recently, through the kindness of Dr. D. T. Lainé of Media, Pa., I had the opportunity of seeing an interesting case of this rachitic pseudo-cretinism. The child is now three years and seven months old. The sutures are closed, and the head shows a prominence in the right parietal region, and also a large depression in the frontal bone of the same side. The face is broad, eyes wide apart, nose flattened, eyelids drooping, and she has slight right internal strabismus. The bones of the upper arm are slightly curved; the lower ends of the radius and ulna enlarged and knobbed, these bones being also slightly bent; the ribs are beaded or irregularly knobbed and the chest contracted; the bones of the legs show some bowing and curving. The spine shows a rachitic dorso-lumbar curve, more prominent on the left. Liver and spleen are greatly enlarged. The child can barely sit up and hold up her head, and has never been able to stand alone. In appearance she reminds one at first glance of a cretin, and is probably a case of infantile osteomalacia. She weighed eight pounds when born, sixteen when five months old, ten when one year of age, and thirty now. When born she was very dark-skinned and hairy all over the body. During most of her life her bowels have been much disturbed, and she had one attack of convulsions when about five months old. She cut her first teeth at fifteen months. During the last year she has slept from twelve to fifteen hours out of the twenty-four. As a rule, she is not cross and cries very little. The family history is not good. The maternal great-

PLATE XVIII.



SPORADIC CRETINISM.

grandparents were cousins; the maternal grandmother has paralysis agitans; the paternal grandmother has "bowel consumption."

Etiology.—Cretinism is especially prevalent in high mountain-ranges remote from the coast; wet or undrained soil appears to have some power for its development; and water charged with lime and magnesia is common in the regions in which it is endemic. Practically, the ultimate cause of cretinism is unknown. Bury (*Keating's Cycl. Dis. Children*) suggests the great importance in future investigations of the causation of this disease of reconsidering the question of heredity, and especially to what extent close interbreeding takes place in the affected districts.

Although one may be present and the other absent, it is undoubted that where goitre exists to any large extent cretins are likely to be found. When the goitre is not present, and even in some cases where it is, peculiar soft, fatty growths may be found in various parts of the body, but usually above the clavicle. In the Philadelphia Hospital case goitre is absent, and also apparently the thyroid, but soft movable masses are found in the neck. By some these are regarded as distinguishing the sporadic from the endemic and epidemic forms of the disease, but this is a mistake.

Pathology.—The pathology of cretinism is perhaps as little determined as its etiology, although much work has been done in this direction by a few observers. The theory which has claimed most attention is that of Virchow, according to whom cretinism is the indirect result of premature ossification of the several parts of the spheno-basilar bone, which in fœtal life consists of three portions separated by cartilaginous disks. Ordinarily, these bones remain separate until puberty, but, according to Virchow, in cretins synostosis takes place at a very early period, and in consequence of this a necessary arrest of the parts at the base of the brain occurs, and consequently of the brain and body in general. While this osseous peculiarity has been found in many cretin skulls, yet in some instances of undoubted cretinism it has not been present; but no hypothesis better than Virchow's has been established.

The conditions found post-mortem and under the microscope are varying in character. The brain-membrane, and particularly the dura, is sometimes thickened and adherent, as it is in not a few other forms of arrest; great variety in the shape and arrangement of the convolutions is found, the tendency being to undue simplicity and smallness of size in important regions; the important fissures of the brain are ill defined or in unusual positions, and shallowness of the fissures is common. Asymmetry both of the cerebrum and cerebellum has been noted, and a few observations have been made on the relative thickness of the different layers of the cortex, showing great abnormalities in this respect.

Diagnosis.—While cretinism may be, and usually is, regarded as a form of idiocy or imbecility or closely related to these affections, it differs from them in several essential particulars, as has been shown by various authorities. The cretin is not necessarily born to this state, although after several generations the offspring are likely to be cretins or cretinoid cases. For a long time the individual shows no sign of cretinism, although doubtless having within him the potentiality of the disorder. Removal from a given locality to a higher situation, even during the pregnancy of the mother, will sometimes prevent the development of cretinism. It differs from idiocy in being so often endemic, in the comparative improvability of some of its grades, and in its apparent dependence upon conditions of air, water, or soil.

It may be occasionally important, as in the case of Dr. Lainé referred to under Symptomatology, to distinguish between true cretinism and osteomalacia,

as treatment in the latter case may be of very great service if begun sufficiently early. The diagnosis can be made by a close investigation for the well-known signs of rickets, such as soft or deformed bones, enlarged liver, and beaded ribs.

Prognosis.—The prognosis of cretinism is of course bad, but some improvement in the higher grades can be made by training, and something can be done for its prevention by early removal from the localities in which it is endemic.

Treatment.—Cretinism, once fully developed, always leaves its stamp upon the individual, but even a low grade cretin is capable of a surprising degree of mental improvement, as has been demonstrated by the enthusiastic philanthropic efforts of Guggenbuhl and others in Europe. In cretinism the physical and mental arrest or deterioration go hand in hand to a greater degree than in idiocy, although, of course, in the latter the truth of this assertion will be measured somewhat by the peculiar form of idiocy which is under consideration.

Monographs and even treatises have been written, to show that cretinism was due to this or that atmospheric, telluric, or other cause. Perhaps in a work of this kind it is better to dismiss any consideration of this matter, except as it may bear upon the prophylaxis of the disease. It has been found by abundant experience that the tendency to cretinism is combated by making careful selection of drinking waters which are contaminated with peculiar salts, as magnesium, iron, etc.; also, that the removal of the mothers who are pregnant, or of the young children who are born in the neighborhoods where cretinism has a tendency to become endemic, to remote and higher districts will sometimes prevent the development of the affection.

Horsley (*Tuke's Dict. Psychol. Med.*) has conducted valuable experimental investigations on the functions of the thyroid gland which have important bearing both on the pathology and treatment of cretinism and myxœdema. He has removed this gland in monkeys, taking careful aseptic precautions, and when the removal has been complete a myxœdematous condition has resulted. Another phase or modification of this experimentation has been to ameliorate by treatment the myxœdema, and then observe the result. This has been an advancing state of hebetude or torpor coincident with the atrophic condition of the thyroid. Such an animal, according to Horsley, died presenting all the appearances of advanced cretinism. The treatment used in these experiments, and one which may be adopted also for the palliation of the myxœdematous symptoms or cretinoid states of the human being, consist, in the first place, in keeping the patients in a warm room or hot atmosphere, thoroughly clothed; secondly, the internal administration of pilocarpine or the tincture of jaborandi. According to Horsley, if the idiocy and the physical state of cretinism are produced by loss of function of the thyroid body, when any of this gland remains an attempt should be made to restore that function. One method by which this could be done is that suggested by Prof. Schiff—viz. transplantation of the thyroid gland. The possibility of this has lately been shown to be more hopeful than might have been expected, by the researches of Esselberg, and the operation has actually been performed upon individuals with cachexia strumipriva, with promising results. Feeding with sheep's thyroids is another method that might be tried.

MYOTONIA, OR THOMSEN'S DISEASE.

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MYOTONIA, or Thomsen's disease, like other family forms of disease, such as Friedreich's ataxia and several types of dystrophy, should receive attention in a treatise on diseases of children; for, although it may develop after puberty, it is most frequently detected before the age of ten years, and it has been observed and studied even in infants. The name by which it is best known is derived from Dr. J. Thomsen of Schleswig-Holstein (*Arch. f. Psych.*, 1876, vol., vi.), who wrote of the affection as occurring in himself and in numerous members of his own family in different generations, although before his time it had been described by Leyden and had been referred to by Sir Charles Bell. In 1886, Erb published a valuable monograph on this subject and a few other articles of more or less value have appeared during the last ten years, one of the most important of these by G. W. Jacoby (*Jour. Nerv. and Mental Dis.*, March, 1887). I recorded a case under the title of "Myotonia and Inertia on Voluntary Effort" (*Intern. Clinics*, April, 1891), and, although this patient was first seen by me when he had reached the age of nearly forty years, he could trace back some of the symptoms of the affection to childhood. When a boy ten years old his father had taken him to a medical college to get advice about his hands, which were even then in some way afflicted with weakness or with clumsiness and difficulty in using them. His feet were also slightly affected in childhood, and he was somewhat stiff in his movements.

Symptoms.—The special symptom of myotonia, or Thomsen's disease, is a tonicity or stiffness of the muscles, with inertia or inhibition of movements coming on with voluntary effort after a long period of rest, the morbid phenomena not being present or not attracting attention during the latter period. The prompt and easy performance of all movements is sooner or later interfered with by the spastic state. After the muscles have been used for a short time the stiffness may pass off, so that the patient who has the greatest difficulty in initiating movements will soon be able to walk with increasing ease, and once fairly afoot may continue to walk without trouble for hours; but after an interval of rest the whole morbid process will be repeated. As a rule, the muscles of the face are not affected, but this is not invariable, and in one of the cases of myotonia reported by me some of the most striking phenomena were exhibited by the muscles of mastication, and in a second case of myotonia and athetoid spasm the facial contortions and snapping of the eyelids were very marked. These cases were adults, although in one of them the affection had originated in childhood, and was probably congenital. Usually the phenomena are most marked in the lower extremities. Sensation is not affected. Trophic changes are not present, but the muscles are bulky, although their strength is not commensurate with their size. Erb and Jacoby have called attention to the peculiar changes in the mechanical and electrical excitability of the muscles.

Erb believes that Thomsen's disease may be diagnosticated by a few closures of the galvanic current and a few blows with a percussion hammer, but this is doubtful, except perhaps in absolutely typical cases. The electrical response has been termed the myotonic reaction. In examining patients for this a large electrode is placed upon the sternum or back of the neck, and another of smaller size in the palm of the hand. Using a galvanic current of sixteen or eighteen cells and allowing the current to flow, a tonic spastic condition of the muscles of the arm occurs. In a little while, particularly after changing the poles with the commutator, curious wave-like contractions take place in a serial, rhythmical order. These undulations move upward or downward according to the position of the anode and cathode—downward when the anode is in the hand, upward when the cathode is in the same position. They move inward from the negative to the positive. Erb has compared the single waves to those produced by a stone falling in water. He considers that the best places for the application are the flexors of the forearm, the palm of the hand, or the volar surfaces of the wrist-joint and nape of the neck. The amount of current requisite for the production of the phenomena varies from six to twenty milliampères (Jacoby). Briefly, the peculiarities of the so-called myotonic reaction are increase and change in the faradic muscular response, while the excitability of the nerves to this current remains normal. Similarly, to the galvanic current the muscles show increased excitability and qualitative changes, the nerve-reaction not being affected. With Jacoby, I have not been able to verify the difference between nerve and muscle application. The mechanical as well as the electrical excitability of the muscle is changed, so that in a typical case tapping on the muscles will cause unusual response, a slight blow, for instance, producing a marked grooving or furrowing of the muscles.

Etiology.—Heredity is the most important factor in the production of the common types of myotonia. It is pre-eminently a family disease, although not infrequently, instead of a family history of the affection clearly myotonic in character, the ancestors, direct or collateral, may have suffered from some form of neurotic degeneration or may have been the subjects of some constitutional taint or toxic affection, as alcoholism. In one family, that of a patient recorded by Bernhardt, consanguineous marriages were frequent, but these may simply have intensified a pre-existing tendency. It is more often a disease of males than of females. Fright, intense emotion, and injuries, have been assigned as exciting causes. Of the cases occurring after puberty, Gowers records one as having resulted from prolonged and severe exertion continued for two years in a man without hereditary tendency, and the same author cites a lightning stroke as a clearly proved exciting cause.

Pathology.—No autopsy supported by careful microscopical examination, so far as I know, has as yet been made. As a rule, the disease has been regarded as essentially muscular, rather than of central or peripheral nervous origin, but this must be regarded as an unsettled question. The relations between the muscular and the connecting and controlling nervous apparatus are so intimate that in the absence of pathological proof the real nature of this or any similar affection must remain in doubt. The primary change may be in the nerve-cells of the cord, of the basal centres, or even of the cerebral cortex, or it may be at the other extremity of the system, in the end-plates in the muscles. The evidence so far is in favor of the disease being muscular and functional. In several instances pieces of muscles have been excised during life, and have been submitted to a careful microscopical examination, and Erb and Jacoby, among others, have made interesting reports upon the conditions present. Erb found an enormous hypertrophy of all muscular fibres and great proliferation

of nuclei, with alterations of the minute structure and a slight increase of the perineurium. Jacoby demonstrated another characteristic change—the distinct division of the muscle-fibres into angular fields, the threads of connecting protoplasm being broken almost everywhere. The motor-nerves and the motor end-plates show no deviation from the normal.

"In Thomsen's disease," says Jacoby, "the motor nerves and motor end-plates do not show any deviation from the normal, so that the nerve impulse is transmitted into the muscle-fibre in the same manner as in the normal condition. The result of the reception of impulse will be a contraction, which, especially after a certain rest, will be a hypercontraction, or, rather, tetanus. This tetanus leads to an agglomeration of a certain number of sarcous elements which break into a continuity of the contracted clusters. In consequence of this tetanus the nerve-influence is inhibited for so long as the tetanus lasts. After the lapse of a few seconds the tetanic contraction will subside, the continuity between the hitherto separated groups of sarcous elements will become re-established, and the propagation of nerve influence will be again rendered possible. We can thus understand the peculiar reaction of the muscles to the various stimuli when applied directly to them, but why the muscles should react differently to indirect stimulation is still inexplicable."

Diagnosis.—Diseases which have some likeness to myotonia are tetany, pseudo-muscular hypertrophy, and some forms of sclerosis. I have also seen a hysteroidal affection which somewhat closely resembles this disease, but the characteristic spastic phenomena and the conditions of electrical and mechanical irritability will prevent mistake on the part of a careful investigator. A form of myotonia, designated paramyotonia, has been described, which differs somewhat from Thomsen's disease, but is also a family affection. One difference which has been noted is that the spasticity is not initiated by voluntary movements, but may be by exposure to cold. Myotonia as a symptomatic affection is observed in several forms of spinal and cerebro-spinal disease; it has been described, for instance, as occurring in connection with ataxia.

Prognosis.—The prognosis of myotonia is unfavorable, although the disease does not particularly shorten life.

Treatment.—No treatment is of any practical avail. The patients may live long lives. Thomsen, speaking from personal experience, believes that active muscular exercise is beneficial. Patients learn by experience to take care of themselves. One of the most serious evils of the disease in one of my cases was the tendency of the patient to have sudden falls, owing apparently to the spastic locking of his muscles. He learned by watching his movements to control the occurrence of these falls. Usually in childhood the disease has not advanced sufficiently to call for special protective measures, unless it be the avoidance of cold and emotional excitement.

ACROMEGALY.

By CHARLES K. MILLS, M. D.,

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Acromegaly, sometimes termed Marie's disease, was first described by Marie about 1886. As the derivation of the word indicates, it means enlargement of the extremities. Acromegaly, as a rule, occurs between the ages of eighteen and thirty years, and therefore the subject is not of first importance in a work on the diseases of children, but a few cases have been recorded as occurring in early childhood, and even as congenital. Recently Moncorvo of Rio Janeiro (*Revue Mensuelle des Maladies de l'Enfance*, Dec., 1892) reported a well-marked case observed in conjunction with microcephalus in a female infant fourteen months old. The mother was a delicate, nervous woman, who during her pregnancy had been subject to violent emotion. At fourteen months the child exhibited congenital microcephalus, idiocy, aphasia, paraplegia, and contractures, and the fundamental symptoms of acromegaly—namely, the retreating forehead; the vertical elongation of the oval of the face; the great enlargement of the nose; the prominence of the superior maxilla; the thickening and advancement of the lower lip; the cervico-dorsal kyphosis, with lumbar lordosis and projection of the anterior plane of the chest, compensated for by flattening of the abdominal wall; and, finally, the spade-like hands, with prominent thickening of the palmar surfaces, and short fingers of uniform width and sausage-like appearance. In another case, cited by Moncorvo from Freund, the disease commenced as early as puberty.

In a series of cases studied by me at the New Jersey Home for the Education and Care of Feeble-minded Children, at Vineland, one remarkable case was found in a boy who was at the time of examination sixteen years old, but who had suffered for years from the disease then present. This boy was the first-born after difficult labor; his mother was feeble-minded, his father a chronic alcoholic; he could dress and feed himself; his speech was imperfect, but he could read and write a little; he was excitable and inclined to be gluttonous. He attended school with very poor results for seven years.

He exhibits two different conditions according to the time when he is studied. For weeks he will be in fairly good health, happy, lively, and disposed to make himself generally useful. His hands and feet are dusky and cold. When the hands are pendent, the dusky area reaches to at least two inches above the wrists, but when they are held above the head the entire limbs become to a less degree of the same hue. He has a marked tendency to indolent ulceration, particularly in the distal portions of the extremities. At the end of the index finger of the left hand are the remains of a formation similar to one which appears from time to time at the end of any of the fingers. The finger-tip swells, and in a little time contains serum and sometimes pus. The toe-nails are black or brownish and ridged roughly. Both hands and feet are abnormally large (Fig. 1). No

loss of sensation was determined. Knee-jerk and muscle-jerk are about normal. He remains in about the same condition for weeks, when a change comes on, almost acutely. His face, arms, hands, legs, and feet swell perceptibly, increasing sometimes almost one half, and this swollen state will last a month or six

FIG. 1.



An Acromegaloid Case.

weeks, and then gradually disappear, leaving him very weak, his pulse at the end of these periods being scarcely perceptible. During the attacks he is obliged to keep his bed most of the time, and is in a condition of general lassitude and depression.

While this case may not, strictly speaking, be one of acromegaly, it is a most interesting allied vaso-motor and trophic disorder, with permanent enlargement and transient changes in the extremities, these increasing at periods.

Symptoms.—Acromegaly is a trophic disease characterized chiefly by a gradual increase in size of the extremities, and usually also of the face. Acromegaly usually begins with progressive enlargement of the hands, feet, and head. The hands and feet may become of enormous size, the other related parts not increasing proportionately. Marie has suggested the name of battledore hands, while the English have sometimes described them as spade-like. Of the parts of the head, the face is usually most strikingly involved, being enlarged particularly from above downward. The hypertrophy attacks both the soft and hard parts. Sometimes the tongue, lips, nose, and lower jaw become enormously increased in size. Rheumatic or neuralgic pains may be present. The skin is often dry. The special senses are sometimes affected; vision, in particular, is likely to suffer. Forms of hemianopsia or sector defects

in vision have been observed. Anæsthesia is not commonly present. The affection as seen in children, so far as reported cases are concerned, has been chiefly in those who exhibit evidences of idiocy or imbecility.

Pathology.—The pathology of acromegaly is practically unsettled. In a number of autopsies which have been made, in almost every case some enlargement of the pituitary body has been present; still, this change is not constant, and some diseases of this organ certainly do not cause acromegaly. A case of pernicious anæmia at the autopsy, in which I took part, revealed a hæmorrhagic tumor of the pituitary body, but the patient had none of the phenomena of acromegaly. In this case, however, as in acromegaly, the fundamental perversion was of nutrition. Efforts have been made to relate the occurrence of the disease to lesions or absence of other organs, as, for instance, of the thymus or thyroid gland. The truth is that the exact pathology of the disease is as yet unknown, although interesting autopsies have been reported. More is known about the peculiarities of the pathological conditions present in various organs and tissues of the body. The bones, particularly the vertebræ, the clavicles, and the long bones of the limbs, are the seat of hypertrophic processes. The bone enlargement is regarded as a true hypertrophy rather than an inflammation, an increase due to surplus of nutritive energy or pabulum, or both. In one case of Virchow's the pituitary body was carefully examined and found to be absolutely normal.

Diagnosis.—The diagnosis of acromegaly is not difficult to make, once on the alert for its occurrence. Other affections in children simulate it to some extent, as, for example, myxœdema and cretinoid disease: true cretinism could not be mistaken for acromegaly. In myxœdema the swelling is not particularly of the extremities, but of the subcutaneous tissues; and the differences in the color and appearance of the skin, and in the condition of the thyroid, will serve to separate it.

What is sometimes spoken of as gigantism might be confounded with acromegaly, but the one differential point is that in gigantism the great disproportion between the extremities and the main portion of the limb is not present. In gigantism the individual may be unusually tall, in accordance with the general increase in all directions, while patients afflicted with acromegaly are as likely to be under as over the average size. The pulmonary osteo-arthropathy described by Marie would be distinguished from ordinary acromegaly by the presence of the pulmonary lesions and the peculiar deformities of the terminal phalanges. Marie has described these deformities as, if observed sideways, having some resemblance to the head and curved beak of a parrot, In acromegaly the nails, if anything, are too small for the parts they cover, while the nails in pulmonary osteo-arthropathy are deformed as well as the fingers. In a disease known as partial acromegaly a considerable hypertrophy of one half of the body, or of a limb on one side, or one side of the face, may be present. In this disease, however, true deformity is always present, and it is usually unilateral and congenital.

Many instances of hypertrophy of the fingers and toes have been reported; they must be separated from true acromegaly, although it is possible that these diseases have something in common, and such cases might be classed under the head of partial acromegaly. Recently a case of this kind was seen by me in consultation, and was presented at the meeting of the Philadelphia Neurological Society by Dr. W. J. Taylor. The first and second toes of the left foot were enormously enlarged, and the third toe was also hypertrophied to a less degree. The hypertrophy was much the greatest in the second toe. This deformity of the foot, according to the mother's statement, was present at

birth, but she thought that the left leg and foot had been growing out of proportion to the right. The nails were thin and imperfect, showing evidences of bad nutrition. Both feet and hands were of good and perhaps of unusual size. Such affections probably have some pathological relationship to the disease here considered, but one which has not yet been clearly determined. Operations are sometimes resorted to for their relief, but the question of the central nature of the affection and its probable progressiveness deserves consideration by the surgeon.

Prognosis.—Acromegaly is essentially an incurable disease, but may make no progress for years.

Treatment.—Some good is reported to have been obtained by the use of remedies like arsenic, the iodides, the alkalies, and special diet. The headache, often present, may be relieved by some of the remedies ordinarily used for congestive or neurotic headaches, as antipyrin, antifebrin, the salicylates, and phenacetin.

ATHETOSIS AND ATHETOID AFFECTIONS.

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Athetosis, a word meaning "without fixed position," is a name first given by Dr. W. A. Hammond to a peculiar mobile spasm observed chiefly in the finger and toes. Strictly speaking, it is not a disease, even in the ordinary clinical sense; it is usually part of a symptom-group which indicates the presence of some lesion of the cerebrum. The movements of athetosis are difficult to describe. They are most commonly observed in the upper extremity of one side, being particularly marked in the fingers and hand, but occasionally they are bilateral. Hughes of St. Louis (*Weekly Med. Review*, 1887) has reported a case of bilateral athetosis coming on in a boy about one year after a railroad accident which caused injury both by concussion and direct violence, although the case was not fully developed for several years. This boy had not complete voluntary control over the movements of his muscles; he could not, by direct effort of the will along the regular channels of nerve conduction, restrain either the rhythmical movements or the spasmodic attitude of the fingers, but he could, by strategy, modify both attitude and movement by bringing one limb to bear upon another and by assuming for the affected limbs flexed positions; but, no matter how much he succeeded in managing these movements, grotesque attitudes would always recur in one or more of the fingers. His affliction unfitted him for occupation requiring manual dexterity. He tried a number of things, but had to give them up because of physical incompetency.

Athetosis is most frequently congenital or an affection of early childhood, occurring particularly in connection with some of the forms of cerebral palsy in children which have been described in this work by Peterson. Church (*Review of Insanity and Nervous Disease*, March, 1892), has recorded an interesting case of symmetrical and universally distributed athetosis in a woman thirty years old, who had suffered from the affection since birth. She was lacking in mental development; face and speech were both affected. Many instances of what might be termed athetoid affections are to be found, particularly among idiotic and imbecile children. These differ from typical athetosis in the irregularity and wide diffusion of the mobile spasm. Several cases of this kind are nearly always present in the nervous wards of the Philadelphia Hospital. One, a mentally defective deaf-mute about thirty years old, has been subject, probably from early childhood, as no history can be obtained, to excessive and irregular movements and distortions, particularly of his face and upper extremities.

Symptoms.—Athetosis, as already indicated, is a word descriptive of a series of grotesque, irregular, and yet monotonous, involuntary movements which are persistent, but subject to exacerbations, and are usually confined to an extremity or the extremities of one side. The movements are more or

less rhythmical, and do not seem to cause the patient fatigue, in this respect being like other rhythmical spastic affections of functional or organic origin. By a strong effort of the will the patient can usually control the movement. As a rule, sensation is not impaired. The muscles on the affected side are often hypertrophied. The condition of the reflexes and so-called reflexes vary, but the knee-jerks and other allied phenomena may be increased on the affected side. As the disease is usually cerebral in origin, electrical changes are commonly not present.

Etiology.—The etiology of athetosis is that of the organic affection of which it is a symptom or with which it is associated. It may be caused by accident, as in Hughes's case of bilateral athetosis to which reference has been made, but whether or not athetosis results will depend upon the particular lesion which is inflicted on the nervous system. The disease has been attributed to fright or undue excitement of the mother during pregnancy, and fright has been given as a special exciting cause in a few instances, but on uncertain grounds. It is much more likely to cause chorea or choreoid affections. Many cases of athetosis and of athetoid affections are associated with well-defined idiocy or imbecility, and are dependent upon the same causes, hereditary, developmental, or accidental, which have led to the latter. According to Strümpell, athetosis may be a sequel of polioencephalitis; and I am inclined to subscribe to this opinion, although the very existence of this disease in children has been denied by authors of ability. Toxic agents by affecting the motor cortex or subcortex may cause this affection.

Pathology.—The lesions in reported cases of athetosis have been largely in the basal ganglia or their immediate neighborhood. In one case a sclerotic nodule was found in the thalamus very near its central upper surface, and in several other instances lesions have been discerned in the same great ganglion; but in nearly all of these cases neighboring parts, as the caudate nucleus, internal capsule, or corona radiata, have also been involved. Undoubtedly, mobile spasm may depend upon lesions either of the thalamus, the striate bodies, the motor cortex, or any part of the cerebral motor tract. In one interesting case of athetoid spasm and myotonia, occurring in an adult, reported by me, and in which an autopsy was obtained, some light was thrown on the character and situation of the lesions which may in some instances produce athetoid spasm. The most striking features were brought out when the patient attempted any voluntary movement, and among other manifestations his fingers were twisted and thrown into a position which illustrated well one of the forms of athetosis of the upper extremity. Many other phenomena, sensory and motor, were present in the case and are detailed in the report (*Intern. Clinics*, April, 1891). The autopsy showed that in both hemispheres, chiefly over the superior and inferior parietal gyri, the dura was adherent to the pia mater, the pia was deeply injected, thickened, and infiltrated with plastic lymph, and in numerous places was more or less firmly fixed to the brain-substance; but the injection, infiltration, exudation, and adhesions were much more marked in the postero-parietal regions than elsewhere. Beneath the area of meningitis both the cortex and the subcortex were softened, giving the appearance on the right side of a sunken, subcortical, or subpial cyst. On the left side of the brain, in a nearly corresponding but somewhat smaller area, was a similar belt of inflammation and softening. Subsequent incisions on both sides showed that the softening included the whole of the gray matter, and involved to a considerable extent the white, but did not invade the ganglia or capsules; it was confined to the supraventricular corona radiata. In cases

unassociated with hemiplegia or diplegia, irritative foci in the motor areas or tracts may give rise to the affection; and Gowers believes that it is sometimes due to impaired nutrition of the growing motor cells.

Diagnosis.—Typical cases of athetosis are not difficult of recognition. Occasionally cases of hemichorea and hemiathetosis in children might be temporarily confused. The movements of athetosis are said to continue during sleep, and this is certainly true of some cases. Post-hemiplegic chorea and athetosis may be confused; and, indeed, chorea secondary to a paralytic attack and this affection differ but little in nature and characteristics. In this work Peterson has described, as occurring in two cases of congenital hemiplegia, an affection to which he has given the name of post-hemiplegic polymyoclonus, in which the movements are neither choreiform nor athetoid, but are chronic, constant contractions of most of the muscles of the limbs affected. The face is seldom affected alone in a disorder which may properly be called athetosis. In athetosis, as contrasted with chorea, the movements, although irregular and bizarre in themselves, have a certain regularity and monotony in their method of repetition, which is not the case with choreic movements.

Prognosis.—The prognosis in the vast majority of cases is bad, as the disease is due to an incurable, often congenital, organic condition. A case of primary athetosis which is quoted by Jacoby from Gnauck (*Keating's Cycl. Dis. Children*, vol. iv.) resulted in complete recovery, and many cases have been reported as improved, but such reports are always of uncertain value. Usually the affection goes on from bad to worse very slowly. Not infrequently, athetosis or athetoid movements are associated with general convulsions, and the latter may be much improved by the treatment employed for epilepsy. Organic athetosis must, of course, from the very nature of the affection, have an exceedingly unfavorable prognosis. A disease which is due to atrophy, sclerosis, neoplastic formations, meningo-encephalitis, or softening, can scarcely be otherwise than incurable. The only point in diagnosis is to separate a few cases of pseudo-athetosis of hysterical or neurotic origin from those of the common type. Hysterical athetosis is possible, has been observed, and has a favorable prognosis.

Treatment.—It follows from what we have already said as to their nature that little can be done in the way of treatment for these interesting but usually hopeless cases. Nerve stretching will temporarily stop the movements, just as it will in cases of histrionic or facial spasm due to organic lesion, but as soon as the nerve has recovered from the traumatism the movements will begin to return, and will soon be present again in their original intensity. Galvanism has been frequently employed, but is of little permanent value. The iodides, bromides, and mercury may be used in cases in which a tumor or meningitis is supposed to be present. Remedies like conium, hyoscine, opium, gelsemium, may be tried, but from the very nature of the cases can only be of temporary value.

INSANITY IN CHILDREN.

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ALTHOUGH juvenile insanity is comparatively rare, it is sufficiently important, both clinically and medico-legally, to demand systematic consideration in a treatise on the diseases of children. It is important not only in itself, but also in its bearings on the mental and physical health of the patient after he has reached adult life. The varieties of insanity which occur in early childhood are largely the same as those of youth and manhood, but they have special characteristics due chiefly to age. These affections are distinct from idiocy, imbecility, and cretinism, although idiotic and imbecile children may have attacks of mental excitement or depression, or other evidences of active insanity. The two conditions of arrest and of acquired disorder must be separately regarded and discussed. Morison, in his *Lectures on Insanity*, speaks of having frequently met with violent and unmanageable idiots of a very tender age.

The mental affections to which particular attention will be directed are those which occur in children presumably born with at least an average degree of intelligent power and possibility. Although it is difficult to separate moral insanity and moral imbecility in children, yet such a distinction can sometimes be made with advantage, and therefore the former will receive brief consideration in this section.

The difference between insanity in the child and in the adult is in harmony with known facts and physiological principles regarding the evolution of the mental faculties. "The insanity met with in children," according to Maudsley (*The Physiology and Pathology of Mind*), "must of necessity be of the simplest kind; where no mental faculty has been organized no disorder of mind can well be manifest." The forms and degrees of insanity exhibited by children according to their stages of mental evolution and their acquired habits have been well discussed by this able psychologist and alienist. Violent and convulsive response to sensorial impressions gives rise to mental disorder of an epileptiform character; or, once the power of definite sensory impression has been acquired, and hallucinations are possible, these may lead to choreic reactions. Some forms of nightmare in children are the result of vivid hallucinations which have arisen in response to such impressions. Hallucinations may occur before the mind is sufficiently organized to make delusion possible; but later, after a varying time, ideas or concepts become organized, so that the child is able to think about absent objects. Ideas which are at first simple and isolated become elaborated and grouped, and as soon as ideas are fully organized, delusion, which is an insistent baseless belief, becomes possible.

True insanity in children has been observed at a very early age; indeed, Greding has reported one case, cited by Crichton and Maudsley, of a child who is said to have been raving mad when it was born. The mother was about forty years old, was of full plethoric habit, and constantly laughed and did

strange things, but otherwise was in the best of health; she was delivered of a male child who possessed so much strength in his arms and legs that four women could at times with difficulty restrain him. His paroxysms of motor excitement either ended in uncontrollable fits of laughter or else he tore everything or anything near him. Mania has also been reported by Greding as beginning at nine months in a child who died at eighteen months old; by Rush and others at the age of two years. Sinkler (*Univ. Medical Magazine*, Jan., 1893), has reported two interesting cases in children three years old. Many cases have been reported as occurring between the ages of five and twelve or thirteen years.

Varieties of Insanity in Children.—It would serve no useful purpose to attempt a formal classification of the insanities of childhood, and it is best, therefore, simply to consider the subject under such heads as experience and published records indicate. All forms of insanity may occur before puberty, although some are very rare. According to Cohn (*Arch. f. Kinderheilk.*, Bd. iv.), juvenile insanity should be divided into functional and organic, under the former subdivision placing those neuroses which may be in part, or may develop into, psychoses, as the insanities of chorea, epilepsy, and hysteria, and also what might be termed idiopathic psychoses, such as hallucinatory confusional insanity, hypochondriacal insanity, melancholia, mania, and moral insanity; while the latter are comprised under such forms as exhibit clear manifestations of organic cerebral disease, as, for example, the rare cases of paretic dementia and mental affections due to tumor, abscess, meningitis, or other determinable lesions.

It will be convenient for practical purposes to arrange juvenile insanities under the following heads: 1, Transitory Psychoses; 2, Mania; 3, Melancholia; 4, Circular or Alternating Insanity; 5, Choreic Insanity; 6, Hysterical Insanity; 7, Cataleptic or Cataleptoid Insanity; 8, Epileptic Insanity; 9, Paranoia or Primary Delusional Insanity; 10, Moral Insanity; 11, Instinctive Perversions and Morbid Impulses; 12, Morbid Fears or Phobias; 13, Paretic Dementia.

A favorite method of classifying insanity, and one which has much that is practical in its favor, is on the basis of etiology, but it has disadvantages, and may be scientifically misleading. In some instances, however, both in adults and in children, special causes are so prominent in the production of certain types of insanity that it serves a good purpose to name the affections from the point of view of causation. Understanding that different forms of insanity from the semiological standard may be produced by the same or similar causes, we may have in children such etiological varieties as *dementia due to inherited syphilis*, *febrile and post-febrile insanities*, *reflex insanity*, *masturbational insanity*, and many others, according to the views of the alienist discussing the subject.

Transitory Psychoses.—Although any form of non-organic insanity in a child is likely to be transient, because it has not the soil in which to take firm root, still certain phases or varieties of mental disturbance in the very young can because of their fleeting character be conveniently classed as transitory psychoses. Under this head would be placed a form of delirium arising in young children from special causes. It is well known to mothers as well as to physicians that some children have a greater tendency to attacks of delirium than others. In them the slightest rise in temperature, as of one or one and a half degrees, will always be attended with more or less delirium. Sometimes this delirium, mild in type and without any special features, constitutes the entire case; but an attack of delirium may be prolonged and take the form

of a true although a transient and non-tenacious mania. The child may have frightful hallucinations, especially of sight or hearing.

Speaking of the insanity of young children, Maudsley well says that "the precocious imagination of a child which sometimes delights foolish parents cannot possibly be anything more than lying fancy; and this for exactly the same reason that the insanity of children must be a delirium, and cannot be a mania —the incomplete formation of ideas and absence of definitely organized associations between them."

Pavor nocturnus, or night-terrors, might be classed with the transitory psychoses of children, but this affection is discussed in another article.

These transient psychoses may take the form of an excited or agitated melancholia, as mentioned by Clouston (*Clinical Lectures on Mental Diseases*, 1884), the patients in such cases screaming, sobbing, weeping, and giving evidence of great mental suffering and depression, usually without being able to give any reasons therefor, although they will sometimes speak of seeing or hearing something, or more or less vaguely of being worried or frightened by apprehensions of evil or injury.

The affection variously known as transitory frenzy, mania transitoria, or ephemeral mania, which in the adult has often been the subject of medico-legal dispute, occasionally has been observed in children—an abrupt, rapid disorder, lasting only a few minutes or hours. Morel (*Maladies Mentales*, 1853), speaks of a little girl eleven year old who after the sudden disappearance of a skin eruption exhibited choreic symptoms, and soon after those of a true maniacal fury in which she became homicidal; and other cases of transitory fury, some traceable to special causes and some not, have been reported by various observers.

Mania.—Mania is the form of insanity of most frequent occurrence in childhood. It usually shows itself by active delirium, great motor excitability, screaming and crying, incoherence, and sometimes by hallucinations, and even delusions of slight tenacity in children old enough to have ideas. Exacerbations of extreme fury or violence come on in the course of the general excitement; convulsions sometimes occur, and speech may be lost, as in a case reported by Morel of a girl ten and a half years old. It was necessary to send her to an asylum, and she never seemed to be happy unless she was destroying something or tormenting somebody. A boy five years old was suddenly frightened, lost the power of speech, was turbulent, and had frequent maniacal paroxysms. These little patients sometimes exhibit great anger and destructive and even homicidal impulses and propensities; but these acute morbid impulses and propensities must be distinguished from those which are due to character, and will be referred to later when speaking of instinctive insanity and morbid impulses.

Melancholia.—Melancholia is not an uncommon form of insanity in children, but it is not likely to occur before the age of five or six years. It is always necessary to distinguish between monomanias or paranoias and melancholias, but genuine uncomplicated melancholia is sometimes seen in children, and has been reported by numerous observers. Hallucinations may or may not be present with the mental depression. Melancholy in a child seldom assumes the extreme form which is observed so frequently in the adult, but now and then a true agitated melancholic frenzy is observed. Ordinarily a child suffering from melancholia will be sad, anxious, weeping, restless by day and by night, wanting in the liveliness and changeability of children—blue, depressed, worried and worrisome, knowing not why. Delusions so common in adults, as of self-condemnation, of the unpardonable sin, of coming to want,

or of fatal organic disease, are often absent in the melancholia of children. Children brought up in morbidly religious or in distressing surroundings sometimes exhibit a delusional state of a religious or painful character, but this does not obtain the same depth and fixity as in adults. The varieties of melancholia most frequently observed in children are the simple, the hypochondriacal, the excited or agitated. Suicide in children is not commonly due to melancholia, although it is occasionally, when an inherited taint will often be found to be present. Children, like adults, are now and then driven to melancholia and suicide by want of care and ill-treatment. The suicides of children are sometimes dependent upon the most trivial causes or notions, as a trifling chastisement.

Circular or Alternating Insanity.—A well-known and most interesting type of insanity in the adult is that which is characterized by alternating mental states, in which, for example, the patient suffers first from exaltation or mania, then from depression or melancholia, then has a sane or lucid period, and again starts on the vicious circle with an attack of exaltation. Sometimes other forms of alternation appear, or simply depression and exaltation in rotation. This mental disorder, which has been designated *folie circulaire*, or circular insanity, and also alternating insanity, is sometimes observed in children.

Choreic Insanity.—Several varieties of choreic insanity have been described. One form of choreic mania usually does not commence until the motor disorder has lasted two, three, or four weeks. Before the onset of the mental disorder the motor disturbances become more severe and irregular; the movements never cease, even in some cases during the little sleep which is obtained, and insomnia becomes almost as complete as in delirious mania. As a rule, the sufferers preserve more knowledge of themselves and their surroundings than would seem likely from the apparent mental disturbance. They do many things which appear to be purposive or hysterical in character, as struggling, striking, hurling things, breaking furniture or dishes, jumping, rolling or thumping themselves against the floor and walls. These cases have been well described by Meyer (*Tuke's Dict. of Psychological Medicine*), who also briefly details the symptoms of acute choreic delirium, in which great excitement with anguish, vivid hallucinations of vision, hearing, smell, taste, and also with stupor, are reported. Fever and evidences of endocarditis are usually present. Idiots not infrequently exhibit choreic disturbances of limbs and language. The insanity of choreic cases is not to be regarded so much as caused by the disorder as an essential part of it, the peculiar delirium, irregular and incoherent, being comparable to the choreic movements themselves.

Hysterical Insanity.—Occasionally hysterical mania and chronic forms of hysterical insanity are observed in early life. Even in adults it may be difficult to distinguish between common acute mania and hysterical mania, and it is sometimes even more difficult in children; indeed, these two affections run more together in childhood. The association of other hysterical phenomena, such as ecstasy, catalepsy, trance, mutism, aphonia, fantastical notions, sensational deceptions, or pseudo-palsies, will be aids to diagnosis. Hysterical mania in childhood usually comes and goes, the attacks being short and showing great emotional excitement. Some, at least, of the acts may be purposive, although apparently beyond control. Sometimes, alternating with these maniacal attacks or independently of them, children are caught in sensational deceptions of such outrageous character, and repeated so often, that they can only be regarded as due to mental perversion. "You may be sure that a young girl is on the premises," says Wilks, "when you read of loud rappings in a house at night,

of a room being constantly set on fire, of sheets torn by rats, and of similar extraordinary occurrences."

Hammond (*Treatise on Insanity in Its Medical Relations*, 1883) records the case of a girl whose disposition was always sullen, capricious, and eccentric, and who never exhibited the least feeling of tenderness toward her parents—who laughed and cried without cause, and committed from an early period of her life all kinds of singular and ridiculous acts. She could not be prevented from using obscene and ridiculous language; and soon she exhibited a series of spontaneous and delirious acts, such as are met with in hysterical mania. One day she crowned herself with flowers, took a guitar, and announced that she was going to travel through the world. She got up in the night and washed her clothes in the chamber-pot. She had convulsive seizures, mewed like a cat, tried to climb up a wall, was violent in her acts toward others, and finally fell into a state of stupor. These accessions were periodical, and it became necessary to send her to an asylum.

The dancing manias, child-pilgrimages, and other epidemic and endemic nervous disorders may be regarded as forms of hysterical insanity; at least they are fundamentally psychoses. Occasionally these endemics from imitation are observed in homes and schools. Usually convulsions, speech affections, pseudo-paralyses, contractures, visual hallucinations, or spells of great emotional excitement are among the phenomena exhibited.

Cataleptic or Cataleptoid Insanity.—*Katatonia*, a clinical type of insanity first described by Kahlbaum in 1874, has in rare instances been observed in children. It is a cyclical or alternating insanity, sometimes having as many as five stages—beginning, for instance, with mania, and then melancholia, stupor, cataleptoid, and dramatic periods following. The different stages may vary in duration and continuation; thus, depression and exaltation may be present with cataleptoid and histrionic phenomena. Some cases recover, and others pass into a state of chronic dementia. It has been claimed that katatonia cannot be regarded as a distinct clinical entity, as various cataleptoid and convulsive phenomena and histrionism are present in other types of insanity, as mania, melancholia, paranoia, imbecility, while others, again, hold that it is an hysterical disorder. It is certain, at any rate, that in childhood mental disturbance of peculiar character, associated with catalepsy, ecstasy, and trance-like states, is observed; and transient maniacal attacks may be present in these cases. Occasionally seizures of this kind have been observed in undoubted epileptics, although the attacks are not to be regarded as epileptic in their nature. A true epilepsy is occasionally developed in children who begin with cataleptic, hystero-epileptic, and hystero-maniacal spells.

Epileptic Insanity.—Congenital epileptics are not infrequently idiots or imbeciles or sufferers from some form of paralytic or atrophic disease; in other cases epilepsy appears early in life in children of fair mental health, some of whom develop epileptic insanity; sometimes a true epileptic dementia comes on even before the period of childhood has passed, showing itself by loss of memory, judgment, and general mental enfeeblement. Mania may occur before or after an epileptic paroxysm, or may take the place of such a paroxysm, just as in the adult. When without sufficient apparent cause a child has transitory fury or frenzy, even though no known history of epilepsy be present, the possibility of the attack being epileptic should be borne in mind. Sometimes very young children have maniacal outbreaks, and subsequently develop regular epilepsy; or the epileptic seizures may be nocturnal, and thus be overlooked; or, again, attacks of *petit mal* may be undemonstrative in character, so that their true nature may not be recognized.

Attacks of fury followed by epileptic convulsions, and of epileptic convulsions followed by furious excitement, in children under ten years of age are recorded by many, and have been observed by every one who has had much experience with epileptic children. Epileptic children also show peculiar perversions of character and manners. Post-epileptic conditions of stupor, delirium, or confusion are sometimes present, and a chronic maniacal state may accompany the epilepsy.

Paranoia or Primary Delusional Insanity.—Paranoia, a Greek word meaning insanity, has been reintroduced into the literature of mental disease. Primary delusional insanity, suggested by Stearns (*Lectures on Mental Diseases*, 1893), is a better term, although even this is open to objection. It is a chronic insanity, in its completest type characterized by recognizable systematized delusions, but showing itself also by general mental instability, insistent ideas, morbid impulses, and perversions of character, the foundation of these being in reality a delusional state. The delusions of paranoiacs may or may not be accompanied by hallucinations. While paranoia is rare under the age of puberty, the children who subsequently develop primary delusional insanity have often such marked peculiarities and eccentricities as to lead physicians experienced in mental diseases to forecast the probable occurrence of this affection later in life. They show oddities of dress and conversation, excess of self-consciousness, a tendency to scheming and dreaming, ambitious and egotistical notions, conceits and misconceptions, and periods of moodiness, depression, anger, or excitement. Recently, Moyer and Lyman (*Med. and Surg. Reporter*, March 25, 1893) have reported paranoia in a boy between twelve and thirteen years old. He imagined that his mother was going to poison him and that he had yellow fever and tape-worms. In a strict sense, he was neither exalted nor depressed. Two maternal grandaunts died insane. This case might be regarded as one beginning at puberty, but now and then a case with definite delusions of a systematized character is seen at an earlier age. According to Spitzka, imperative conceptions, morbid fears, and *folie du doute* are frequent in infantile masturbators, and hypochondriacal and persecutional paranoia in a crude form is similarly detected at this period.

Moral Insanity.—It is difficult, as already stated, to make a distinction between moral imbecility and moral insanity in children, and sometimes the distinction is of little importance. In moral insanity the perversion of the moral or affective life may be brought about by injury, disease, or vicious habits in children who to all appearances have been of healthy moral and mental tone. The moral imbecile is the victim of heredity, his condition being manifested as soon after birth as it is possible to recognize deficiencies in the moral sense. Extraordinary perversions of character have been recorded in considerable number due to acute fevers in children. Psychical phenomena approaching attacks of true insanity sometimes occur during malarial fevers, and sometimes seem to take the place of malarial attacks.

Instinctive Perversions and Morbid Impulses.—Instinctive perversions and morbid impulses flow out of the same inherited or constitutional conditions which are at the root of fully-developed monomania or paranoia. Children who show these perversions and impulses sometimes later in life become examples of paranoia. Maudsley prefers to consider these symptoms or conditions under the general head of affective insanity, under which he would also include moral insanity proper. With regard to both adults and children it is important to determine whether such manifestations are symptoms of mania, melancholia, or epilepsy, or whether they are constitutional or paranoiac in type. One must have a clear idea of certain terms now frequently used in

considering these questions, such as concepts, imperative concepts, morbid concepts, imperative acts or movements, insistent ideas, and morbid propensities. *Concepts* are distinct or isolated thoughts, the elements of thought-processes; they become imperative when they dominate or tyrannize the mind. *Imperative acts or movements* or morbid impulses are the results of these imperative conceptions. The term *insistent idea*, suggested by Cowles, describes a habit of thought resulting from the repetition and multiplication of morbid concepts; after a time these insistent ideas hamper and manacle the individual's will and intellect. *Morbid propensities*, like insistent ideas, sometimes steadily hold possession of the mind; they are often simply exaggeration of the normal propensities, but to such a degree as to become a true insanity. They are perversions chiefly of the desire for food and of the sexual appetite.

Under morbid impulses, monomanias, partial ideational insanity, and partial moral mania have been described such affections as moral mania; homicidal mania or the impulse or propensity to kill; suicidal monomania; kleptomania or the propensity to theft; erotomania or the tendency to fall in love with everybody; nymphomania which may be distinct from erotomania and exhibit itself in sexual precocity and salacity; pyromania or the impulse or propensity to incendiarism; and dipsomania or the irresistible periodical craving for drink. It is perhaps better to regard these as designations of the most prominent symptom or symptoms in a case of insanity, rather than to erect them into a special variety of mental disease, although the latter procedure sometimes serves a good practical purpose.

Almost every variety of monomania or morbid impulse has been observed in young children, and many cases might be given. Esquirol speaks of a girl aged five years who repeatedly attempted to kill both her stepmother and her brother. Not a few cases have been reported like that of the boy Pomeroy—children who have shown an insane inclination to cruelty as well as to homicide, this often exhibiting itself in a tendency to give pain, to mutilate, to harm in various ways the lower animals or other children. Such cases usually belong to the inherited paranoiac type, but in others the inclination to injure or kill may be simply one of the violent manifestations of a curable acute mania.

Both thieving and lying can sometimes only be regarded as true mental perversions, although it is certainly difficult in the child as in the adult to separate such forms of monomania from conscious and controllable viciousness. Girls at or approaching puberty are known to exhibit such tendencies to a morbid degree, in many cases recovering from them in a shorter or longer time, but occasionally even younger children show the same monomaniacal inclinations. Such a child will lie without rhyme or reason, and will steal without a desire to gratify appetite or passion.

What is known as erotomania is more frequently exhibited in adults than in children, but rare juvenile cases have been observed. Erotomania and nymphomania are not the same, although often confounded. In erotomania, as a rule, the tendency to indecency and excess is not present. The erotomaniac boy becomes the adorer of most of the girls he meets, or the girl the admiring slave of the boys. Nymphomania or satyriasis exhibited in an insane degree is by no means uncommon in children, and even occasionally in very small children, both boys and girls. Cases have been reported of children two and three years old who have exhibited the most remarkable sexual precocity, as shown by indecency of attitude and act.

Some of the most extraordinary instances of morbid impulses and propensities in children are those which have been reported as cases of pyromania, the child persistently and perversely striving to set fire to anything and everything

that it thinks will burn, and using sometimes great cunning and skill both to succeed and to conceal the act.

Hammond relates the case of a girl less than fifteen years of age, affected with nostalgia, who twice set fire to the house in which she lived. She declared that from the first minute of entering her master's house she had been seized with the desire to destroy it by fire. It seemed to her that a ghost standing before her constantly urged her on to the act. This girl had suffered from pain in the head and disordered menstruation.

Morbid Fears or Phobias.—In a philosophical sense, sanity and insanity are relative terms whether applied to conditions in children or in adults; certainly, not a few cases are observed which may be properly regarded as on the borderland between mental health and disease. They are perhaps best regarded as examples of partial or quasi-insanity; that is, forms of mental disease which in a certain manner and degree have the attributes of insanity. They are abortive or imperfectly-developed mental disorders. Sometimes they are as transient in duration as they are limited in phenomena; but in other instances the few elementary deficiencies or disturbances may persist without much change or increase through life. Many of these cases, like the morbid impulses just treated of, belong under the head of paranoia. They have been described as morbid fears or phobias, as morbid doubts, as emotional monomanias, and even as forms of neurasthenia. They are fundamentally dependent upon the domination of the mind by morbid concepts and insistent ideas. They are sometimes observed among young children, although more common after than before the period of puberty. Morbid fear may be the result of functional disturbance or disease in a normally constituted individual, but the cases which afford the most striking instances of morbid fear or phobia occur in those who have not been subjected to any physical or mental strain sufficient to break down a healthy organization. Persistent fear of the monomaniacal type occuring in children is rarely due to overwork or fatigue, as at school, as is frequently supposed. The real cause is generally in a child's progenitor or progenitors. They are cases of the class referred to by Oliver Wendell Holmes, the cure of which should have been begun two hundred years ago.

These quasi-insanities or phobias have been much divided and subdivided; not infrequently several of the so-called varieties are present at the same time in the same case. Among the forms of morbid fear which have been described by particular names are *pathophobia*, or fear of disease; *myscphobia*, the fear of contamination, defilement, or pollution; *agoraphobia*, the fear of open squares or places; *claustrophobia*, the fear of closed or narrow places; *topophobia*, the fear of places in general; *monophobia*, the fear of being alone; *pyrophobia*, the fear of fire; *astrophobia*, the fear of lightning; and *hydrophobophobia*, or fear of hydrophobia. Some cases belong to a class which may be described as *pantophobia*, or fear of everything.

A few cases have been observed in comparatively young children. Hurd (cited by Stearns), reports an interesting case from an account written by the patient herself. When about twelve years old she began to have strange fancies, as fearing the blood flowing from a cut finger would harm those who came near her. Subsequently, dressing, walking out of doors, eating, were all greatly interfered with through the same morbid ideas. She feared contagious diseases because she might communicate them to others. The insistent idea changed from time to time, but seemed to spring always from the emotion of fear. She eventually recovered. Hammond cites from King, of Sedalia, Missouri, an interesting case of pyrophobia in a boy of ten years. Day and night he was infested with fear of this kind. On one occasion, when the morning

was cool, he succeeded, after a contest with his mother, in opening the stove-door and pouring a bucket of water on the fire. He is said to have been cured by quinine, the bromides, and the use of evaporating applications to the head.

A few cases in comparatively young children have been reported and some have come under my notice. A boy eleven years old, developed what was practically a pantophobia, although his disorder exhibited itself chiefly as a pathophobia, or fear of disease. He was kept almost constantly under the care of physicians. Sometimes his morbid ideas revolved round real affections of slight importance; sometimes his fears and suffering were due purely to morbid conceptions and insistent ideas. Now his eyes were the source of morbid dread; soon his limbs were the seat of rheumatic pain; he narrowly escaped laparotomy for typhlitis, probably of psychical origin; to a moderate degree he suffered from mysophobia, spending unusual time at his ablutions, teeth cleaning, in dressing, and in the care and arrangement of his clothes. Anything in the nature of a symptom or a disease mentioned in his presence was likely to take possession of him. His morbid notions and apprehensions were fed and encouraged by the unceasing attentions of members of his family. He was practically cured by taking him from his home-surroundings, disregarding his complaints, forcing him to do things on time and after the manner of others, at the same time carefully but not obtrusively looking after his general health.

Another boy at the age of ten began to develop the scrupulous and mysophobic type of monomania; in fact, he was, as so many of these cases are, an illustration of the admixture of several of the so-called classes of morbid fears. He was constantly worrying about many things he said and did in his intercourse with others. If left alone, he would spend hours in bathing and washing himself, and often imagined he had been polluted or would contaminate others. The symptoms were in many respects like those of the lady described by Hammond, and to whose case he first applied the term mysophobia, who could touch nothing without being irresistibly impelled to wash her hands, and who in many other ways was tormented by the fear of contamination. This boy improved greatly under mental discipline, out-door exercise, and careful tonic medication.

These cases of morbid fear, particularly when they assume the form of pathophobia or dread of disease, are sometimes incorrectly regarded as examples of hypochondria or hypochondriacal melancholia, but they differ from the latter as monomania or paranoia differs from mania or melancholia.

Paretic Dementia.—From its nature and pathology paretic dementia is essentially a disease of adult life. It usually arises in patients more than thirty years of age, and is most common between the thirtieth and fortieth years; but occasionally it is observed in the aged, and in very rare instances in the young. The youngest paretic dement observed by Spitzka in 346 cases was eighteen years old. Other cases, however, still younger, have been reported, as one by Turnbull (*Jour. Mental Science*, October, 1881) in a boy of twelve years, who was first observed by the reporter at the age of eighteen years. Up to the age of ten he had been healthy and apparently like other boys, but at this age he had an attack of hemiplegia, which passed off in a week and left him with a certain amount of stupidity. He continued to perform his duties as a messenger-boy, but from the age of twelve a mental weakness increased gradually but distinctly. His symptoms, as described, were certainly those of general paralysis, except that he had not delusions of grandeur. The boy died in less than a year after his admission to an asylum, and the post-mortem findings were those usually seen in cases of paretic dementia.

Etiological Varieties, and General Etiology.—*A form of juvenile dementia, the result of inherited syphilis*, sometimes occurs, and it is necessary to separate this from idiocy and imbecility, whether of syphilitic or other origin, which may be done by remembering that the dementia usually comes on after the child is four or five years old, and therefore when the mental condition has been determined not to be that of idiocy. In rare cases, however, it happens that a juvenile or infantile dementia occurs when the child is two or three years old, so young that its true mental status has not been fully determined. With this word of caution as to the possibility of inherited syphilis showing itself in a child otherwise healthy in the first year or two of life, most of the cases of this form of dementia will be comparatively easy of recognition. A family history of syphilis will often, but not always, be obtained; often the upper incisors will be pegged and notched, while cicatrices at the angle of the mouth and the characteristic physiognomy will be present; and sometimes the child will have attacks of keratitis, choroiditis, or iritis, or a history of snuffles or of a rash, and sometimes epilepsy will have developed.

Febrile and post-febrile insanity is, on the whole, not rare in children. Many cases have been put on record. They have been arranged by Nasse into three classes—those coinciding with the fever, those which are apparent continuations of the fever, and those developing during convalescence. According to Spitzka (*Keating's Cyel. Diseases of Children*), the latter group is more benign in character and prospect than the other two, and is most often found in adults, the first two groups being more frequent in children. Of course delirium is an accompaniment of most fevers, and this is more pronounced and sometimes of a peculiar character in childhood; but, setting aside ordinary febrile delirium, mental disorder sufficiently intense and persistent to be classed as insanity is of comparatively common occurrence. The fevers during which or after which insanity is most likely to develop are typhoid, scarlatina, measles, rheumatism, and diphtheria. Owing to the intensity of the psychical phenomena, the true nature of typhoid fever in the child or adult is sometimes overlooked. Most cases of febrile and post-febrile insanity recover in periods varying from a few days to a few weeks or months. Rarely, however, a true dementia is originated, and when this does result the child is sometimes left weaker in mind and less capable of development than before the attack.

Under the head of *reflex insanities* might be included a large variety of cases, chiefly illustrations of mania, which has been attributed, and apparently with correctness, to splinters in the great toe, to a carious tooth, to ascarides and other varieties of intestinal parasites, to rectal and preputial irritation. In one case seen by me in consultation a tape-worm was the apparent cause, as the symptoms disappeared when the parasite was discharged. Affections of the nose and throat and digestive disturbances are other assigned causes of juvenile insanity; probably such causes simply act as excitants in children who are predisposed by heredity to mental disease. Some of the conditions which are regarded as causes are really due to the mental condition. Spitzka refers in this connection to the functional disturbances of the digestive apparatus in girls about the age of puberty, who go on from slight dyspeptic symptoms until they get an aversion to food, and sometimes even delusions about eating, so that they may actually starve to death, forced feeding being resorted to too late.

Masturbational insanity, as occurring both in children and adults, has been both overrated and underrated, but, on the whole, the tendency has been to the former rather than the latter. Some alienists deny that this vice is ever the true cause of insanity, holding that it like the insanity is due to the neuropathic state of the individual, or that at the most, it is merely a concomitant or

aggravating cause. My experience leads me to believe that while, as is known to almost every one, the vice is extremely common, especially among boys, it only in rare instances is the true cause of mental disease, but that these instances must be recognized. Of recent writers, Spitzka has laid the most stress upon the existence of masturbational insanity, and has ably described it from his point of view. According to this writer, the typical masturbational psychosis occurs between the thirteenth and twentieth years, and therefore at a time which just removes the subject from consideration in an article on diseases of childhood proper; but occasionally the same symptoms and conditions are observed before puberty, although before this period Spitzka believes that the dementia is more like a true imbecility, and that infantile insane masturbators are more liable to epileptiform attacks than to outbursts of mania.

Juvenile insanity may be directly inherited, but far more frequently, it is the tendency rather than the psychosis which is inherited. Besides syphilis, which has already been considered, alcoholism exerts its sinister influence in this as in so many other directions. Neurasthenia, hysteria, chorea, epilepsy may be present in the immediate ancestors. Other causes are great heat or cold, exposure to the sun, variations in temperature, and fright which acts unexpectedly, especially to excite the maniacal or hysterical forms. Injuries to the head are of so much importance as to almost warrant the creation for purposes of convenience of a class of traumatic juvenile insanities. In many of these traumatic cases the mental affection is of the maniacal type, and is often associated with epileptic or vertiginous attacks. Sometimes insanity originates in connection with disease of the heart or some form of kidney affection, although these causes, and particularly the latter, act much more frequently in adult life. Poor food, bad ventilation, and bad hygiene generally, may be auxiliary causes.

Diagnosis.—Much that has already been said in the general consideration of the subject, and also in connection with the discussion of special varieties of insanity, will assist in the diagnosis. In the first place, insanity in childhood must be distinguished from idiocy and imbecility, or the existence of both in the same case must be determined. The delirium which ushers in or accompanies a continued or ephemeral fever must not be set down as insanity, the febrile disease being overlooked, although, as has been considered, the occurrence of true febrile insanities must be borne in mind. The distinction between vice and insanity is not always easy to make either in the child or in the adult. I agree with Tuke (*Dict. Psychol. Med.*), that it is difficult to lay down rules to differentiate moral insanity from moral depravity; each case must be decided in relation to the individual himself, his antecedents, education, surroundings, and social status, the nature of certain acts and the mode in which they are performed. Hysterical excitement or mania may be difficult to distinguish from mania of either toxic or unknown origin, but the past history of the child, and the presence of certain hysterical stigmata, such as aphonia, convulsions, or paresis, will be of great assistance in making the diagnosis. The existence of epileptic insanity can often be determined by a close investigation of the history of the case, which will sometimes unexpectedly reveal the fact that the child has had at least serious *petit mal* during the day and probably spasms during the night. Every child who has sudden and unaccountable outbursts of extreme violence should be watched for a time both day and night with the view of determining as to the existence of larvated epilepsy. It is sometimes highly important to decide as to the type of insanity from which a child is suffering. If the symptoms point to paranoia or primary delusional insanity, even if of an imperfectly developed form, the prognosis will not be as favorable as if the child is suffering from true mania or melancholia. The mode of onset, the condition

of the logical faculties, the amount of emotional manifestation, will aid in the diagnosis, and the trained observer will recognize in the paranoic child that the changes are fundamentally those of temperament and character. Transient morbid fears and doubts must not be always regarded with great apprehension. Children, like adults, are subject when neurasthenic to such fears and doubts, but these only arise to the importance of mental disease when persistent, progressive, and of peculiar character. Their importance should be neither overrated nor misunderstood. Paretic dementia is so rare in children that its diagnosis has not much practical importance; the only point of interest would be, in a case which simulated general paralysis, to decide whether it might not be one of juvenile dementia due to inherited syphilis, rather than a true paretic dementia of unknown origin. Much help will be given in the diagnosis of the latter by a study of the physical evidences, such as interstitial keratitis, choroiditis, acute iritis, and optic neuritis. The eye should always be carefully examined in suspected cases. The occurrence of deafness independently of acute aural disease is important. Notching and pegging of the incisor teeth, fissuration of the corners of the mouth, flattening of the bridge of the nose, and changes of the knee-jerks may be other physical evidences.

Prognosis.—On the whole, the prognosis of insanity in childhood is good, but differs somewhat with the varieties. The transitory psychoses, mania, melancholia, circular, choreic, hysterical, and cataleptoid insanities generally recover under appropriate treatment. The rare cases of primary delusional insanity, and the more numerous instances of morbid perversions, impulses, and propensities, while they may be recovered from in whole or in part, are likely to lay the foundation or to be the precursors of serious mental affections later in life. This, however, is not the invariable rule. Young patients suffering from morbid fears or phobias, worried and driven by insistent ideas, may be much benefited, and sometimes permanently relieved, by a treatment which consists more in moral management, discipline, and general hygiene than in the use of medicines. These cases also sometimes become instances of life-long monomania of mild or severe type. Dementia due to inherited syphilis may be arrested if recognized sufficiently early. True paretic dementia is practically hopeless in the child as in the adult. Some cases of masturbational insanity are rescued; others pass into incurable dementia, or at least to a lower plane of mental life.

Treatment.—"Great care," says Tuke (*Op. cit.*), "has to be given to the surroundings of the patients, especially in acute mania. If the patients have to keep in bed, the quiet of being in a room without noise or without exciting impressions is to be preferred to isolation in a cell, but one scarcely ever can do without the padded room. Lukewarm baths, with cold showers on the head and back if wanted, are very useful, because of the good they do to the skin, which is in many places injured." In the treatment of mania at home every effort should be made, in the first place, to remove sources of irritation and excitement. The child should be kept in a room away from the rest of the family, and noises and to some extent even light should be excluded. The bowels should be thoroughly opened if they show any tendency to constipation, but sometimes the reverse is the case. Attention should be given to the action of the skin and the kidneys, using diaphoretics and diuretics, either alone or in combination with some of the remedies to be presently mentioned, for the more striking manifestations which are present. Food should be systematically urged upon the patient, although in some cases the tendency may be to eat too much rather than too little. It will rarely be necessary in mania, or even in melancholia, in children, to resort to feeding either with the

nasal or the stomach tube, but this should be done rather than to let the child go for several days with little or no food. The food should be of a digestible character, and should be such as can be easily taken or given to the patient, as milk, broths, milk toast, egg custard, soft boiled eggs, or tender meat.

Sleeplessness and excitement are among the most important indications to be met with in the mania of children by such remedies as chloral, bromides, conium, hyoscine, or other preparations of hyoscyamus, sulphonal, opium, cannabis Indica, acetanilid, antipyrine, chloralamid, amylene hydrate, paraldehyde, somnal, urethan. Of these the most valuable in the treatment of acute mania in children are the bromides, chloral, hyoscine hydrobromate, conium, sulphonal, and opium. The doses should be proportioned to the age of the child, bearing in mind, however, that larger doses can be borne than in children not suffering from extreme mental excitement. It is a good plan to combine bromides and fluid extract of conium, with or without chloral, in one preparation, to be given four or five times daily, and in addition to use one or two doses of about $\frac{1}{200}$ to $\frac{1}{150}$ of a grain of hyoscine hydrobromate twice daily. The combination of bromides with tincture of cannabis Indica will be sometimes found very serviceable.

The melancholia of children is generally of brief duration. It should be treated, in the first place, by rest and change: a trip to the seashore or to the country or mountains will sometimes be quickly efficacious. All the secretory and excretory glands and organs should be kept in good condition. Fruits, laxatives, mineral waters, salines, syrup of figs, and preparations of aloin, strychnine, and belladonna, combined with cascara or podophyllin, will serve a good purpose in regulating the bowels. Opium is of more service in melancholia than in mania, and may be used in small doses combined with bromides. Squibb's deodorized tincture of opium is excellent. Food should be regularly administered, and even in children the very careful use of stimulants may prove advantageous. The preparations of malt will be found preferable. Various combinations of tonics and digestives will prove of service, among the best being nux vomica with liquor pepsin, the compounds of calisaya, iron, and strychnine, and arsenic in the form of Fowler's solution administered with the compound syrup of hypophosphites.

The treatment of choreic insanity is practically the treatment of a bad case of chorea, plus that of mania. In a severe case seen in consultation, a girl eight years old developed chorea shortly after an attack of scarlet fever, and the movements were incessant, violent, and uncontrollable; the patient sleepless and at times semi-delirious. Arsenic, cimicifuga, bromides, and morphine had been used without effect, but the following treatment was successfully adopted: At first she was ordered Squibb's fluid extract of conium and Fowler's arsenical solution, each 5 minims, well diluted, every two hours; and also hydrobromate of hyoscine, grain $\frac{1}{96}$, every two hours until some effect was produced. Clysmic water was ordered to be taken freely, and poultices were used over the kidneys. The choreic movements abated somewhat, but after two doses of hyoscine had been administered she had a hysterical convulsion, the tongue became very dry, and her delirium increased. The hyoscine and arsenical solution were discontinued in about twelve hours, and she was then ordered Squibb's fluid extract of conium and tincture of digitalis, each 5 minims, every two hours, with neutral mixture. This treatment was kept up steadily for forty-eight hours. One dose of chloral, 30 grains, and bromide of potassium, 60 grains, was given by rectal injection. The poultices and clysmic water were continued, and a purgative was also administered. The chorea showed marked

improvement in forty-eight hours. The conium and digitalis were continued, but with gradually decreasing frequency, for a week. Two or three doses of chloral, of 10 or 15 grains, were given in the latter part of the day. Great attention was paid to the administration of nourishment, chiefly in the form of milk.

In epileptic insanity, or when epilepsy is suspected, bromides should be administered, guarded by arsenic, and at the same time nutrients, such as cod-liver oil and the preparations of malt, and also tonics in small doses, should be given.

The remarks made in another chapter about the treatment of moral imbecility will apply with almost equal force, at least in most cases, to the treatment of moral insanity; but the cases which have been referred to as arising from traumatisms, toxic diseases, and blood-poisoning should be borne in mind when considering the question of treatment. Doubtless some of these may be amenable to surgical or medicinal treatment. When children are found to suffer from instinctive perversions and morbid impulses, they should be watched with the greatest care; they should be kept as far as possible from temptations; their moral training should receive particular attention, and as far as possible they should lead healthful out-door lives, great care being observed as to the choice of their companions. In some cases these perversions and impulses pass away at puberty or adolescence. The treatment of children who are the victims of morbid fears and doubts, of pathophobias, mysophobias, pyrophobias, and the host of other phobias, is worthy of careful thought. While the tendency which has led to these disturbances is usually inherited, much may be done to prevent their full development, and in some instances the affections may pass away under appropriate treatment. Such children often require to be removed from their home-surroundings, as almost invariably mistakes are made by their parents and guardians either in the direction of too much sympathy and coddling or of too much harshness or want of appreciation of the disorder. They should be prevented from constantly thinking about themselves, their aches and ailments, and if any real disease be present, it should receive appropriate but not too anxious consideration. They should be disciplined to act promptly in all cases—to act twice before thinking once.

By no one better than by Clouston has the treatment of masturbational insanity as occurring in youths been discussed, and some of his advice and rules are applicable to the disease in childhood. The paramount indication is to brace up the youth mentally and morally. As soon as the child can be reached by judicious instruction, efforts should be made to strengthen both bodily and mental inhibition. The mistake should not be made of unnecessarily calling the attention of young children to their genital organs and sexual feelings; occasionally parents and physicians err in this direction. A healthy child should be let alone, and too much anxiety and interference should not be shown because of some physiological sexual manifestation. Ordinary attention to health will often suffice to keep a child straight. My own view, as already stated, is that mental disorder in children from masturbation may occur, but is not common, and that the habit sometimes weakens children who are mentally and physically deficient from other causes. The physician or parent should not take for granted, as is done so often, that a large majority of the nervous and mental symptoms and affections of children are attributable to this vice. Some mothers and fathers seem to live in constant worriment about this matter, and are always suspecting their children of self-abuse. Clouston's particular suggestions with reference to the treatment of this form of insanity must of course be qualified by considerations of age. "Avoid flesh," he says, "as the

incarnation of rampant, uncontrollable force, sexual and otherwise. Be much in the open air, work hard. Finally, so fill up and systematize the time that none is left for day-dreaming."

Spitzka holds that painful corporal punishment should follow every attempt by infants at touching the privates or executing friction, as to no other argument is so young a child accessible. It is doubtful whether this advice is of universal application, but it is perhaps best followed in some cases. As soon as children are old enough appeal can be made to the sense of shame and of self-respect. Any local source of irritation, such as adherent prepuce, irritative affections of the genito-urinary apparatus, and worms in the alimentary canal, should of course be removed, although this last source of trouble is likely to be overrated.

IMPERATIVE MOVEMENTS IN DEFECTIVE CHILDREN: ALSO HEAD-NODDING, HEAD-SHAKING, HEAD-ROTATING, HEAD-BANGING, AND NYSTAGMUS IN INFANTS.

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Under various but similar names, such as head-nodding, head-jerking, head-rotating, and head-banging, certain acute affections in infants and young children have been described. The reports of these cases show that they differ in character, and to such an extent that for the practical purposes of prognosis and treatment distinctions must sometimes be made between different varieties. Among the authors who have contributed to our knowledge of this subject are Henoch, A. Baginsky, S. Gee, Stephen Mackenzie, and, more than all, W. B. Hadden (*Lancet*, June 14, 1890, and *St. Thomas' Hospital Reports*, 1890) and for most of the facts contained in this brief sketch I am indebted to the valuable papers of the last named.

Imperative Movements in Defective Children.—Before considering the affections described by Hadden, it should be borne in mind that in well-known organic affections of the nervous system, so-called imperative movements, due to dominating conceptions and insistent ideas, may be present either in children or adults. These may take the form of the salaam or bowing spasm, of snapping the eyes, of contortions of the face, of shrugging of a shoulder or shoulders, or of some repeated movements of the arm, trunk, or leg; or, again, they may be some peculiar combination of movements executed together or in succession. They may in other rare instances be shown as an irresistible tendency to touch some special point or to handle an object in some particular way. Occasionally such imperative movements are associated with explosive expressions which may be of profane or obscene character, and to these I have referred in discussing speech-defects and anomalies. Among the idiotic, interesting instances of imperative and automatic movements are observed. At the New Jersey Home for Feeble-minded Children at Vineland one little epileptic patient has at frequent intervals attacks of head-shaking, nodding, and jerking. Another girl has curious recurring rhythmical movements which can be started by music or by beating monotonously some object, as a fan or desk. Holding one hand open with the little finger of the other, she rapidly vibrates the fingers of the open hand or, standing squarely on her feet, she continues for a long time a semi-rotary movement of the trunk, at the same time tossing the head from right to left and bending the body from side to side.

At the Pennsylvania Training School for Feeble-minded Children at Elwyn is, or was, a little patient familiarly spoken of as "The Dervish." The

boy was of small stature and weight, a demi-microcephalic epileptic and mute idiot. At all times he was subject to certain automatic tricks with his hands, putting them and twisting them into various positions. Periodically, almost every day, he gave exhibitions of the habit which had led him to be called The Dervish. He commenced by tattooing his chin with his left hand; next he deliberately and delicately touched the fingers of his left hand to the wrist of his right, made two or three salaams, and then impulsively gyrated the body from left to right.

Sometimes peculiar movements are associated with ordinary epilepsy in children not imbecile or idiotic. At least some of the cases particularly described in this article may have some alliance with eclampsia nutans of the salaam convulsion form, to which affection the terms nodding spasm, spasmus nutans, and eclampsia rotans have also been applied.

HEAD-NODDING, AND HEAD-JERKING.—The cases particularly described by Hadden in his series of papers on "Head-nodding and Head-jerking in Children, commonly associated with Nystagmus," are, in his own words, "characterized by nodding or lateral movements of the head, either singly or associated with one another or with movements of rotation. Further, these movements of the head may be almost constant, or may occur more especially during efforts at fixation or during excitement, always ceasing during sleep or when lying down. In most cases there is nystagmus of one or both eyes, vertical, horizontal, or rotary, often occurring simultaneously with the onset of the head movements, but sometimes preceding or following them. The nystagmus is much more rapid than the head movements, and has an independent rhythm; it is aggravated by attempts at fixation or by forcibly restraining the head, and may even be induced, when previously absent, by these means."

Hadden's first observations were based on an analysis of twelve cases. His second series included nine cases of which he had kept notes, although in all he had seen fourteen since the publication of his first series. His deductions from an analysis of twenty-one cases can be summarized as follows: Pure nodding, like the movements of a mandarin doll, is rare; in others the movements were lateral, although combined or alternated nodding or rotation was common. He sees no reason for subdividing the cases into nodding and shaking as separate classes, as one of these movements may replace the other. The movements are chiefly seen when the child's attention is attracted to an object, and are increased each time it makes a new effort at fixation. They cease during sleep and when the child is lying down and when the eyes are covered. The associated nystagmus is rapid and of short range, and is not constantly present, the movements of the eyeball being usually horizontal or combined with some rotation. In one case the head-nodding and nystagmus were vertical, and in another the nystagmus was confined to one eye and associated with side-to-side movements of the head.

The pupils were almost always normal. Hippus or oscillation of the pupil was present in some cases. No unhealthy ophthalmoscopic appearances were found. In nearly half of the cases the children had a tendency to cock the head on one side or to hold it in some other unusual position when looking at an object. In a large percentage of cases they had attacks as if consciousness was in abeyance—seizures much resembling in character the descriptions given of *petit mal* or epileptic vertigo. Convulsions were present in a few cases, and attacks of convulsive laughter were observed in one child. Rickets was present in nine out of the twenty-one patients.

HEAD-BANGING.—An affection has been described by Gee (*St. Bartho-*

lomew's Hospital Reports, 1886), as head-banging, in which children have a habit of turning on their faces at night and banging their heads into the pillow. According to Gee, the affection is perhaps a habit. As few of these cases have been recorded, I give Gee's brief account of three cases:

"I.—Gilbert G——, two and a half years old when seen with Dr. Donald Hood, had been affected thus for two or three months past. At night in bed, both when awake (half awake?) and when sound asleep, he would turn over on his face and bang his forehead into the pillow. In this way he sometimes behaved nearly all night long; in which case, it need hardly be said, he awoke very weary. He never had convulsions of any kind; indeed, no disorder, past or present, other than head-banging. A year and a half afterward this disorder continued when he was not tied down in bed. He had never suffered from nightmare or sleep-walking. (Four months after the last notes the patient's mother told me that he continued to bang his head at night when not tied down. Even when tied down he rolls his head from side to side, being asleep. Put asleep with a younger brother, the latter began to bang his head also; separated, he, the younger child, lost the habit. The first boy continued healthy and cheerful.)

"II.—George H——, five years old, a patient of Mr. Patten's, was backward in understanding and speaking, but there were no signs of cretinism. He was a first child, born at full time after a long labor in which no instruments were used. He had knock-knees and splay-feet, but his dentition was very regular. He was restless, but clean in his habits, and never wet the bed. There were no other signs of disease. He never had convulsions of any kind. Head-banging began when he was two and a half years old (that is to say, as soon as he could hold his body up), and it had continued until the time when he was seen. He used to turn over on to his face and bang his forehead into the pillow about six times in succession. The act was seldom repeated in the same night, and seldom occurred more than one night in four. He was fast asleep at the time, but was easily roused.

"III.—Francis C——, two and a half years old, had been subject for six months to banging his head on the pillow at night for two or three hours at a time. He had an inguinal hernia; he had erections of the penis at night; he masturbated, and the foreskin was adherent; otherwise the child seemed well. A year afterward Mr. J. Lucas Worship wrote this about him: 'While he was staying in Sevenoaks, about a month ago, he was better of knocking his head about, but the nurse said that whilst at home it was as bad as ever. He was a great deal in the meadows, and slept well from being in the open air so much, which he was unable to get while living at home in the town. He was operated upon for his phimosis, which is all right now, and he does not masturbate since then.'"

At the meeting of the Pennsylvania State Medical Society in May, 1893, two interesting cases of head movements were reported, the first by Dr. J. C. Gable of York, Pa., to whom I am indebted for notes. The patient was a girl ten months old, well developed and apparently healthy at birth. The family of the child was of more than ordinary intelligence, but had a pronounced neurotic and tubercular taint. The mother suffered from chorea when a young girl. The paternal grandparents died of pulmonary tuberculosis, and an aunt suffered from an attack of tubercular arthritis of the right knee, which eventually necessitated a thigh amputation. When the doctor was first called to see the little patient he found her suffering from singular and seemingly very distressing semi-rotatory, oscillatory bowing or bobbing movements of the head. These were somewhat varied in character and degree, but continued with a monotonous, rhythmical regularity, as long as the child remained awake, during a month, and then gradually began to diminish, and ceased entirely in about eight weeks. There was no nystagmus, nor any other special symptom except a somewhat demented expression of face, which caused the anxious parents to fear that the child was suffering from unsoundness of mind, until assured that its complaint was a special and a rare form of chorea, which yielded to zinc treatment and proper hygienic measures.

The second case was reported by Dr. J. C. McAllister of Driftwood, Pa., who also has kindly furnished me with brief notes. The child was born in April,

1892, with forceps delivery, the labor being the first and quite difficult; but the baby was, however, a strong and well-nourished boy, and no history of nervous trouble in the family could be obtained. In February, 1893, when the child was about ten months old, the doctor was consulted for the relief of choreic movements of the hands and arms, and also for certain nodding and rotatory movements of the head. Aside from this, constipation was the only symptom. Bromide of potassium and Fowler's solution were prescribed for the movements, and the constipation was also treated. After a few weeks the bromide was stopped, but the arsenical solution was increased to two drops four times a day. The infant had a long prepuce, and the doctor performed circumcision, April 26, 1893. The movements of the hands ceased under the use of the arsenic before the operation, but the other movements continued until after the circumcision, when they gradually disappeared.

Nystagmus.—Nystagmus may be described as a constant involuntary movement of the eyeballs, which is usually horizontal, but sometimes vertical, and even in rare cases may be in a slightly oblique direction; and rarely also the vertical and horizontal oscillations may alternate regularly or irregularly, or a vertical movement may be present in one eye and a horizontal in another. The commonest form of nystagmus is that in which the movement is bilateral, horizontal, and consentaneous. Nystagmus is present in several organic affections of the nervous system, as in disseminated sclerosis, and to a less degree in other forms of sclerosis, diseases of the cerebellum, and hereditary ataxia. It is sometimes due to local affections of the eyes which interfere with sight, as opacities of the cornea or of the lens or humors of the eye. It is very common in albinism, and is, as is well known, of frequent occurrence among miners. As an affection of children it is chiefly of interest as it occurs either in rare cases of cerebellar or other form of brain tumor, or as it occurs associated with head-jerking and head-nodding, described in this article. Nystagmus seems to be an essential element in a majority of these cases, and Hadden describes and discusses these movements as follows:

"This is very rapid, about four to six movements per second, and of very short range. One mother said it was 'like Perry's pens at the underground stations,' and this homely description is not inapt. Nystagmus is not usually constant; not infrequently it has to be induced by making the child fix objects here and there, by forcibly restraining the movements of the head, or by placing the child on its back. On two occasions it was especially well marked when the child was put to the breast. I verified this by personal observation.

"The movements of the eyeballs are usually horizontal, combined with some rotation. As a rule, the movements of the head and eyes are in the same direction, but this is by no means invariable. In my solitary case of head-nodding the nystagmus was vertical, whereas in another patient there was vertical nystagmus limited to one eye, associated with side-to-side movements of the head.

"There is occasionally a relation between nystagmus and the position of the eyes or evident ocular state. In one case the nystagmus was exaggerated on extreme conjugate deviation to the right. In two instances the nystagmus was chiefly evident when the eyes were directed upward, and in one of these it was generally horizontal, and tended to become vertical when the eyes were turned upward. The nystagmus may vary in direction apart from this; in two instances the nystagmus was sometimes vertical, sometimes horizontal, and sometimes rotatory."

Nystagmus may be the only form of movement present in cases exactly similar in nature to those in which the head movements are also present; as Hadden put it, the disorder may be indicated by nystagmus alone just as there may be tabes dorsalis without ataxia or paralysis agitans without shaking. He gives one instance in which nystagmus alone was present for a year, but after this the patient showed occasional slight movements of the head.

Etiology.—In some of the reported cases a decided predisposition to neurotic disorder was present. In six out of the twenty-one cases a history of convulsions in other children of the same family was obtained. Rickets was present in the family in three instances, and decided evidences of rickets were shown in nine out of the twenty-one of Hadden's patients. The affection often appears to be due to reflex irritation from the alimentary canal or from dentition. Henoch attached great importance to dentition as a cause, but on it Hadden does not lay so much stress. Head-jerking occurs sometimes at an age before the process of teething has begun, and a history of injury to the head, usually by falls, has been present in a large number of cases. The affection is more common in females than in males. In the majority of cases it begins between the ages of six and twelve months. Usually the head movements and nystagmus occur simultaneously at the onset.

Pathology.—The pathology of the cases of imperative movements described is that of the idiocy or imbecility with which they are associated. With reference to the nature of head-nodding cases, Hughlings Jackson has suggested that they are a variety of spinal chorea, a symptomatic condition allied to canine chorea; but Hadden believes that the seizures point to instability of motor-centres above the nuclei in the spinal cord and fourth ventricle, and he would therefore attribute the disorder to a functional or other disturbance of the cerebral cortex. The child has acquired certain voluntary or purposive movements of the head and eyeballs, but these have not as yet become thoroughly organized and fixed in the psycho-motor areas of the brain; hence a dissolution takes place because of the inability of the strained cortical centres to stand the work to which they have been too early subjected. He compares these head movements to the tremors in the head which often occur in aged people and those seen sometimes in adults.

Diagnosis.—The chief point in the diagnosis of these cases is to distinguish between the different varieties of head movements, particularly as to their occurrence in children otherwise healthy or diseased. Imperative or automatic movements suggest the presence of idiocy or imbecility, and should lead to a study for these affections. Knowing that epilepsy is an accompaniment of some forms of repeated head movements, the existence of this disease should be determined or dismissed. Bearing in mind a few important facts of this character, the explicit and careful descriptions afforded by Hadden and Gee will serve to identify these curious cases.

Prognosis.—As a rule, these little patients recover, the disorder lasting for varying periods. Sometimes the movements will pass away in a few weeks, and at others several months or even one to two years may elapse before recovery takes place. Nystagmus is said to persist longer than the head movements, and shows a greater tendency to recurrence. One case was observed by Hadden for two years and a half, nystagmus not being present. In making a prognosis a distinction must be made between the acute and curable cases, such as have been reported by Hadden, Gee, and others mentioned in this chapter, and the patients suffering from idiocy, imbecility, epilepsy, or other serious

forms of mental or nervous disorder, who are the victims of imperative and automatic movements described in the beginning of the chapter.

Treatment.—Any sources of reflex irritation should be carefully attended to, but in this, as in many other cases, reflex irritation has been made a scapegoat for ignorance or imperfect knowledge. The general health of the child should be carefully looked after, although in some of the reported cases this seems to have been very good. The somewhat frequent occurrence of rachitis should give this constitutional condition an importance in connection with therapeutics. Fatty and albuminous foods in easily-digested form should be given; cod-liver oil in some of its various combinations, as with lime or malt; maltine with pepsin and pancreatin; iron, particularly in the form of the powder or the carbonate; glycerin, cream, peptonized milk, and such nutrients as are commonly chosen in rachitic cases, may prove of service in some instances, as are also such medicinal remedies as Lugol's solution of iodine; Donovan's solution of arsenic, mercury, and iodine; Fowler's solution of arsenic, the syrup of the hypophosphites, and similar strengtheners and builders. Iodide of iron, tartrate or malate of iron, and phosphate of sodium may prove useful. Among the remedies which are supposed to have some influence upon the disorder bromides hold the first place, but they should be given with care, and not in the same doses as in undoubted epilepsy. Five to seven grains of bromide of potassium or sodium, with two or three minims of tincture of belladonna, or one minim of the fluid extract of conium, may be used with advantage, and at times this dose may be increased until a decided impression is made. Sulphonal or chloralamid in small doses is worthy of trial. The children are usually not old enough to have their eyes refracted. In view of the theory that the condition is allied to canine chorea, and in the light of the suggestion of H. C. Wood (*Jour. American Med. Assoc.*, February 25, 1893), that in chorea, and particularly canine chorea, the inhibitory apparatus which controls motor power in the spinal cells is weakened to a greater extent than is the discharge power, and also that quinine has a great controlling power over choreic movements in the dog, the importance of at least trying quinine in increasing doses in the treatment of these movements is suggested.

HEADACHE.

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The term "headache," which defines itself, is used to describe pain due to causes either outside or inside of the cranial cavity. Its general synonyms are cephalalgia and cephalæa, and for one of its most common varieties the synonyms are migraine, megrim, hemicrania, or sick headache. Headaches in children are less frequent in occurrence, fewer in varieties, and less severe in type than in adults. Headache is most frequently a symptom of some recognizable functional or organic disease, and its occurrence in many affections, such as infectious fevers, will not, of course, here receive consideration. The wisdom of discussing headache separately has been questioned, and with good reason; but it may be the ruling feature of a case which is presented to the doctor for diagnosis and treatment, and if it is banished from the picture little is left except to the most critical research, although even in such a case careful study will generally show that it is simply a symptom of some rheumatic, dyspeptic, hysterical, inflammatory, or other morbid state.

The mechanism of pain in the head is worthy of brief attention. It is a well-known fact, although one often overlooked, that the brain substance is practically insensitive, and pain in the head, even when the result or the accompaniment of disease of the brain, is not due directly to lesion of its tissue. The brain of man and of the lower animals can be excised without giving rise to any sensory response, although the gentlest electrical application to a motor centre may excite the liveliest movement. Nerve end-organs, which are an essential portion of the apparatus of sensibility, are wanting in the brain itself. Disorders of sensibility due to disease of the brain tissue are referred to more or less distant parts of the body. The membranes of the brain play an important rôle in intracranial pain, as has been shown by Duret (*Brain*, April, 1878), Ferrier (*Brain*, January, 1879), and others. The dura is highly endowed with nerves of sensation derived from the trigeminus, and in rheumatic or neuritic headaches and in those due to organic disease the pain is frequently dependent upon direct involvement of these nerves. The pia or pia-arachnoid membrane is not so largely supplied with sensory nerves as the dura. The pia is largely an immense network of vessels, whose supply is from the gangliated nervous system, and is concerned in head pain through variations in pressure and tension within the cranial cavity, as well as to a less degree by direct nerve irritation. Inflamed arteries and veins cause pain, probably through their direct or indirect influence upon nerves of sensation. Blood charged with toxic matter also causes pain both by direct and indirect irritation of nerves. In explaining headaches it is necessary, then, to consider neural or membranous inflammation, alterations in pressure or tension, and toxic states of the blood.

The varieties of headache which best deserve to be ranked as special types are (1) migraine, and (2) the headaches of organic intracranial disease. Other so-called varieties are usually based upon etiological considerations, and will be considered under that heading. It is indeed of questionable propriety to class migraine as a headache, and this is only done because it seems to be the most practical method for physicians likely to use a general treatise on diseases of children. The disease is migraine, and headache is only one of a series of important phenomena—visual, gastric, motor, and mental; but it is the symptom which causes the patient the greatest suffering and for which he appeals for help.

Migraine.

Migraine, megrim, hemicrania, or sick headache is by no means uncommon in children. Sometimes very young children have mild attacks of sick headache; these at first come very seldom, and apparently only under special exciting causes, as over-eating, excitement, or exhaustion; and at first the intervals between the paroxysms may be many weeks or months, but gradually they become shorter. At first, also, the attacks can be scarcely recognized as genuine sick headaches, pain not being prominent, but as years progress they become more prolonged and severe; still, under the age of puberty, however clear may be the type, migraine does not usually assume the severity and intensity which it shows after this period. I have seen a few instances of migraine in children under six years of age. A boy, now ten years of age, began to have mild attacks of migraine at the age of three, at first having only two or three attacks a year, but these gradually became more and more frequent, until now he averages a spell about once a month. A history of migraine is present in four generations—in the mother, and in the maternal grandfather and great-grandfather. Three other children in the same family are not affected in the same way. The child in other respects is unusually robust and free from disease.

Symptoms.—Except that the symptoms are less pronounced and severe and have fewer concomitants, the phenomena of migraine in children are practically the same as in adults. It perhaps shows less tendency to recur at regular periods. The child may suddenly or unexpectedly exhibit an indisposition to play, may look pale and troubled, may complain of nausea or of being chilly, or may speak of disturbances of sight; then the pain comes on, and at first is often confined to one temple or at least to one side of the head. Soon it becomes more and more severe, and the little patient, without urging, is glad to go to bed in a quiet room. The pain may last for hours or the better part of a day, or in some instances in young children it is relieved in an hour or two, usually by vomiting, followed by sleep. The migraine of childhood is not so likely to occur early in the morning as in adult life. The visual prodromes are comparatively common in children, although they may be absent. They may take the form of photopsia, as balls or rims of fire or zig-zag colored lines, or hemianopsia, or general obscurity of sight. The more complicated and profound cerebral phenomena sometimes seen in adults, such as amnesic aphasia, hemiparesis, monoanæsthesia, and hallucinations of sight or great mental perturbation, may be present, but are not as common in children as in adults. Putnam (cited by Sinkler, *St. Louis Med. Review*, October 29, 1887), has recorded a case of a patient in whom, in boyhood, migraine was represented by repeated attacks of numbness and tingling in the right side of the face and right half of the body, with aphasia and hemianopsia, followed by a trifling headache or none at all; but later in life he had attacks of pain. The pain of migraine is usually one-sided, and may be confined to the supra-orbital or

temporal region. The attacks are usually much the same, except that they grow in severity as the years advance. Nausea and vomiting are of frequent occurrence, but not invariable.

Etiology.—Heredity is the most important predisposing cause of migraine, as of some other forms of headache. Of exciting causes, excessive fatigue, mental or nervous exhaustion, and indigestion are the most important. Disorders of digestion are often placed in the front rank of exciting causes, but it may be forgotten that the nausea and vomiting are frequently of central origin. Rheumatic weather seems to have an influence in precipitating attacks of migraine.

Pathology.—The pathology of migraine is practically unknown, as no theory which has been advanced has well withstood the attacks made upon it. It does not explain its true pathology to show that attacks may be induced or excited by eye-strain, or disordered digestion, or intestinal putrefaction. These attacks are certainly sensory explosions, analogous in their methods of exhibition to the spasms which result from discharges of the cortical motor centres. Migraine, as has been claimed, has many of the appearances of sensory epilepsy. Cortical discharges of the visual cerebral centres would best explain the curious and frequent visual prodromes. Whatever may be its pathology, it is, as a rule, a cerebral affection. Anstie regarded migraine as a variety of neuralgia of the first or ophthalmic division of the trigeminus; and in favor of this theory is the occurrence of certain local trophic affections, such as herpes zoster, ulceration of the cornea, and changes in the color of the hair; but cases of neuralgia or neuritis of branches of the fifth nerve, not instances of true migraine, are sometimes confounded with the latter. In the so-called tic-douloureux and in other less severe forms of painful disease of the branches of the trigeminus, trophic disorders are frequent. True migraine and trigeminal neuralgia or neuritis may be present in the same case; indeed, the affections sometimes blend in the same person. Migrainous subjects are vulnerable to the same influences as are neuralgics and neuritics; but these and similar facts do not prove that the disorders are identical. Much stress has been laid upon the exact state of the vessels of the brain during attacks of migraine. According to one view, in one form of hemicrania the blood-vessels of one side of the brain or of a limited area of the brain are in a spastic state, while in another variety a paretic state of the vessels exists. To explain the pain Du Bois-Reymond held that the spasm of the vessels caused pinching of the nerves in their sheaths.

Diagnosis.—A clear understanding of the usual prodromata and of the method of progression of the symptoms is the best key to the diagnosis of migraine. It is perhaps most likely to be confounded with headache of organic origin, particularly with tumor and meningitis. The ophthalmoscope and various localizing symptoms which will be spoken of hereafter will greatly aid. Hysterical or imitative headaches in children may occasionally closely simulate migraine, particularly in children whose parents are victims of the disease.

Prognosis.—The prognosis of migraine as to cure is bad. Usually the attacks become more frequent as the child grows older.

Treatment.—For attacks of migraine in children energetic active treatment does not seem as necessary as in adults. As soon as the prodromes appear the child should be placed in a quiet, darkened room, away from sources of irritation and depression. Phenacetin, antipyrin, antifebrin, and caffeine are among the most useful remedies for the abridgement or the mitigation of the attacks. Four or five grains of antipyrin or antifebrin, with two or three minims of tincture of digitalis or tincture of strophanthus to protect the heart,

may be given every hour or two until three or four doses are taken. Caffeine, or the citrate of caffeine, in doses of one to two grains every half hour, will sometimes abort an attack if given early. Once an attack has fully developed, it is, as a rule, best to let the patient alone or only to use external applications, as of hot water to the head or feet or menthol or chloral-camphor or mild galvanization to the forehead and head. An emetic of ipecacuanha is sometimes efficient, and the administration of a large dose of this drug may afford relief even when it does not produce emesis.

The treatment of migraine during the intervals of the attacks is of considerable importance. Everything should be done to keep the child in the very best general condition. Cannabis Indica has been much praised for adults, giving it in increasing doses, beginning with one-tenth or one-twelfth of a grain three times daily, and continuing the treatment systematically for months; but its use for children, like that of other narcotics, is not to be encouraged. Arsenic, quinine, iron, hydriodic acid, and the hypophosphites are of benefit, particularly in debilitated cases; but it is not my experience, as it seems to have been of others, that migraine in childhood is likely to occur in subjects who are weak, anæmic, and sedentary. The most robust and hearty child of a family may be the sole victim of the disorder, although this is not invariably true. Great attention has been paid in recent years to the relief of eye-strain in the treatment of this affection; and, while the favorable results of ocular treatment have been overstated, measures directed to the eyes should not be neglected. Hypermetropia, myopia, and astigmatism should be corrected if sufficient in degree to clearly cause discomfort or annoyance. The eyes should be examined under atropine, and the correction should be as complete as possible. Tenotomy or partial tenotomy may need to be performed, but too much in a curative way should not be expected from these measures. In particular, children who are going to school and paying close attention to their studies should have their eyes investigated. Imperfectly ventilated and badly-lighted school-rooms and house-rooms probably count for much as exciting causes of migraine.

Some children suffer from forms of headache which have many of the characteristics of migraine, but cannot be said positively to belong to this type. These children, most commonly young girls at school, have attacks of head-pain, accompanied with nausea or with both nausea and vomiting, which compel them to rest and cause them to be irritable and worrisome. These headaches are often associated with constipation. They are sometimes entirely relieved by a change from a sedentary to an open-air life. They recur so frequently that the term "recurrent headache" has been used in describing them, although this expression has been applied also to other forms of headache. They differ from typical migraine in the absence of prodromes and in their lesser severity. They might perhaps be termed migranoid cases. Like typical migraine, such headaches are often observed in children of neurotic heredity.

Headaches due to Organic Disease.

Intracranial tumor, meningitis, abscess, and, in very rare instances, aneurism, may be the cause of headache in children. Headache is rarely absent in brain tumor, and sometimes causes extreme suffering, but occasionally a growth may be present without this symptom. The tumors which are most likely not to give rise to pain are the gliomata, probably because these neoplasms are not usually connected with the brain membranes, and also because owing to their soft

structure, they exert comparatively little pressure. Much of the horrible pain commonly present in intracranial tumor is dependent upon irritation of branches of the fifth nerve in the dura, and this does not always occur in gliomata, because, as has been stated, they may be unconnected with this membrane. In several instances I have observed cases of gliomata of the cerebellum in which pain was unimportant; but it remains true that in children, as in adults, headache is a very common symptom of an intracranial growth. In infants and very young children, the sutures still remaining open, the pressure within the cranium is not increased to the same extent as in adults by a developing tumor. The location of pain in the head is sometimes, although rarely, a guide to the position of the growth, but at the best it is an uncertain guide. A constant occipital pain may indicate a neoplasm in the posterior fossa, but often this will be deceptive. Patients with cerebellar tumor may complain of severe frontal pain. In tumors pain in the head is usually increased by percussion, and in some instances this pain will be greatest over the seat of the disease.

Tubercular growths or conglomerations are common in tuberculosis in children, and in these cases more or less tubercular meningitis is present, so that the diagnosis of the cause of the headache, as between an isolated growth and a meningitis, becomes difficult. The headache of tubercular meningitis is often of great intensity, and this disease may be accompanied, like other affections of the cerebral membranes, and particularly of the dura, with vertigo, nausea, vomiting, and screaming or crying; but, while this is true, headache is not an invariable accompaniment of cerebral meningitis, and particularly of lepto-meningitis of slow development.

Occasionally the source of a severe headache is a cerebral or cerebellar abscess, which is usually of rapid development, as long-latent abscesses are not likely to occur in children. Such abscesses are commonly found in association with disease of the middle or internal ear, and the pain will be more or less referred to the location or neighborhood of this organ.

The diagnosis of tumor, meningitis, or abscess as the cause of a headache will be made by a careful study of the accompanying conditions. The most common of these will be, first, such general symptoms as optic neuritis, nausea, vomiting, vertigo, monospasm, or convulsions, mental irritability, or depression, apoplectiform attacks, and paralysis of cranial nerves or of the face or limbs, hyperæsthesia, anæsthesia; and, according to the seat of the growth, special phenomena, such as hemianopsia, or cerebellar titubation. As tumors of the cerebellum are somewhat common in children, the particular symptomatology of growths in this location should always be borne in mind. These symptoms, in addition to the headache, vertigo, vomiting, hyperæsthesia, optic neuritis, etc., just described, are, or may be, unsteadiness in station or gait; nystagmus; sometimes internal squint; frequent blindness; sometimes deafness; enlargement of the head from acquired hydrocephalus; rigidity of the muscles of the neck with retraction of the head; loss of knee-jerk, or occasionally striking peculiarities of the knee-jerk. Sometimes pain is marked in the neck and back. These symptoms point particularly to tumor of the middle lobe of the cerebellum.

Among organic headaches may be classed those which are due to inherited syphilitic affections, but which are not necessarily either growths or meningitis. The headache which accompanies the epileptic paroxysm also must not be overlooked in considering this class. As is well known, it may either precede or follow the epileptic fit, or it may be present with slight attacks of petit mal which are scarcely observed. Catarrhal headache of inflammatory origin,

according to Allen (*Med. News*, March 13, 1886), is seen occasionally in acute congestion or inflammation of the frontal sinuses. The pain, which is severe, is usually confined to one side, but it is rare in children.

Etiological Varieties of Headache.

The predisposing causes of headache in children are few, the exciting causes are many, and numerous classes or varieties of headaches have been erected, based chiefly upon etiological considerations. These etiological varieties may be indefinitely extended, and it is chiefly for this reason that authors differ so much in their classifications of headache. Even the headaches of children have been subdivided into numerous classes, as into the so-called school-headaches; the headaches of the period of growth; anæmic, hyperæmic, and neurasthenic headaches; headache of the eye-strain and of genital irritation; and so on through a long list, according to the inclination or views of the classifier. The causes of organic headaches have necessarily been given in the course of their general discussion. The great predisposing cause of migraine, as has been stated, is heredity; the exciting causes are those also of headache of any type, as excessive fatigue, mental or nervous exhaustion, disorders of digestion, changes in the weather, badly heated and ventilated rooms, lack of exercise, impoverished or altered blood (anæmia, hyperæmia, or toxæmia), overwork, excitement, undue exposure to heat or to cold, eye-strain, gastro-intestinal disorders, genital irritation, nasal or pharyngeal catarrhs, or aching teeth. A close consideration of the causes or alleged causes of headache in children will show that in addition to migraine and organic headaches we might conveniently erect the following etiological varieties: 1, anæmic headache; 2, reflex headache; 3, hysterical headache; 4, neuritic headache.

Anæmic Headache.—Anæmic headaches sometimes occur in children, although with not nearly the same frequency as in adults, and especially in women. A few children seem to inherit an anæmic diathesis, just as others are congenitally rachitic. These children are pale in skin and mucous membranes, sometimes to the extent of being chlorotic; they lack in strength and in nerve energy; they are neurasthenic as well as anæmic. It is rare, in children, to see a neurasthenic or exhaustion headache not associated with impoverished state of the blood; and therefore the distinction between a neurasthenic and an anæmic headache can be more sharply made in the adult. The diagnosis of an anæmic headache is to be made by a careful investigation for the evidences of anæmia, even to the extent, if necessary, of a blood-count. It is well to remember that every pale-faced child is not anæmic, and also that some children who are well supplied with fat may have poor blood.

Reflex Headaches.—While too much stress is laid upon reflex action as the source of innumerable maladies, it plays an important part in many cases of headache, as in the production of other symptoms. When a child complains of headache after study or use of the eyes at close work, as in drawing, writing, or sewing, the eyes should be investigated. Serious defects of refraction may be present, particularly hypermetropia with astigmatism, and these, if sufficient to cause strain, should be at once corrected. Children who indulge in over-eating or careless eating sometimes suffer in consequence from headaches, which are relieved by spontaneous vomiting or by the use of emetics or cathartics; but it must be remembered that true migraine in children is associated with nausea and vomiting, and that the gastro-intestinal disorder in these cases is a concomitant rather than a cause of the headache. Perhaps too much stress has been laid on sexual irritation as a cause of headaches in children, but that it may be occasionally causative cannot be doubted. Allen

(*loc. cit.*) has presented some points of practical importance in connection with reflex headache, in association with chronic nasal catarrh, which have a bearing on the headaches of childhood. These reflex headaches are said by him to be almost entirely restricted to the temple and the vertex. Sometimes nausea is present, and sometimes if a probe, passed into the nose, is made to touch the middle turbinated bone, vertex pain will instantly follow. The inner wall of the orbit is often peculiarly sensitive, and the nasal mucous membrane is in a state of intense inflammation. The reflex headaches of chronic nasal catarrh are sharply separated from the headaches of cerebral disease by the absence of any symptom referable to cranial sources, the lack of evidence, as furnished by a history of the case, that the complaint is of central origin, and the complete control of the pain by local treatment. Allen distinguishes reflex catarrhal headache from sick headache of gastric origin by the absence of furred tongue, and from the temple pains of eye-strain by its persistence after the correction of errors of refraction. Such headaches may be the cause of nervous prostration. Reflex headache may also have its origin in the pharynx or even in decayed teeth.

Hysterical Headache.—A frequent form of headache, even in children of tender years, is the hysterical headache, or what might perhaps be better termed, in most instances, the imitative headache. Most children, and particularly those of the precocious and affectionate type, are fond of sympathy and coddling. They are very close observers of the sufferings and peculiarities of others. They have slight pains and aches, and these become headaches apparently of very great severity. Often a child who complains of vertical headache, or of headache associated with inability to stand the light, or of great pain over the eyes or in the back of the head or neck, will be found on close inquiry to have a father or mother, and especially a mother, who is subject to similar aches and pains. Just as hysterical and hystero-epileptic convulsions, aphonia, paresis of one or more limbs, and even hysterical blindness, may be simulated or mimicked by the child of a neurotic parent, so headache and other pains and aches in children are even more frequently to be traced to the same source.

Neuritic Headache.—Some children, usually of neurotic, rheumatic, or arthritic heredity, suffer from pains in the head and face which are accompanied by tenderness and pressure over exposed nerve ends and trunks, and also are commonly increased by pain on movement of the scalp. These mild but annoying head pains are due to forms of subacute or chronic neuritis, which may or may not be associated with slight inflammation of other tissues. Head pains and headaches of this kind are much influenced by the weather. Even when external tenderness is not present, pains in the head may be due to inflammation of the branches of the fifth nerve in the dura, or in the grooves or foramina of the skull, or in the scalp. These cases usually yield rapidly to antirheumatic or antineuritic treatment. Since the occurrence of the recent prolonged epidemic of influenza many cases of chronic headache or of chronic head and face pains have been observed, chiefly in adults, but now and then in children. Most of these have been due to a lingering neuritis or to the want of tone in nerve centres, left wounded or vulnerable by the ravages of this disease.

Diagnosis and Prognosis.—The diagnosis of headache in general relates chiefly to the differential diagnosis of its varieties already considered. When pain in the head is present, the general diagnosis of headache is made, the only point of importance being to distinguish as to whether it is due to intracranial or extracranial causes. The points already given under the general varieties of headache will serve in the main for their differentiation. I would simply lay

stress upon the necessity of separating those forms due to pronounced organic disease from migraine and from functional types, such as the hysterical, the neurasthenic, and the rheumatic. Proper but not undue attention should be given to the question of reflexes. The prognosis of headaches has already been sufficiently considered in speaking of its different varieties.

Treatment.—The treatment of the headaches of children will depend largely upon the special variety. The treatment of migraine has been discussed; that of organic headache will be largely of the underlying disease. For the relief of these headaches two classes of remedies should be employed: first, those for the immediate relief of pain; and, secondly, those to improve the state on which the headache depends. For the immediate relief of pain the best remedies are phenacetin, antipyrin, antifebrin, bromides, chloral, sulphonal, chloralamid, codeine, hyoscine, ether, chloroform, and preparations of opium. These remedies should be used in doses proportioned to the age of the child, although it should be remembered that children suffering from violent pain, wherever located, will stand larger doses of hypnotics and narcotics than those in health or those who are suffering from non-painful diseases. In brain tumor and meningitis phenacetin and antipyrin in combination will sometimes afford great relief.

For the constitutional or the acquired organic conditions on which some headaches depend, mercury, the iodides, hydriodic acid, arsenic, and similar constitutional measures will be found most beneficial. In most cases mercury is best used in the form of minute doses of the bichloride.

As not a few children who suffer from chronic headache are both anæmic and neurasthenic, it is of great importance first, to pay attention to these conditions, and the best treatment for adults will not always answer in these cases. Preparations of iron and arsenic should be given, but care should be taken in their selection. Among the most useful iron preparations are the malate, the citrates of iron and quinine, the ammonio-citrate of iron, the lactate of iron, powdered iron, and dialyzed iron. Palatable preparations can be readily chosen with a little care. Arsenic alone or in some combination will often be found extremely useful. I prefer small doses of Fowler's solution alone or in combination with the compound syrup of the hypophosphites. In these anæmic children most careful attention should be paid to the quality of the food and to the manner of giving it. Much headache in American children and in adults is associated with the dyspeptic troubles which are so common in this country, and which are not infrequently due to the use of the frying-pan and to other evil methods of preparing food. Children with their fresh and vigorous digestive organs do not suffer so much in this way as adults, and particularly those who have reached middle age or who have passed into the decline of life; still, the matter is one of practical importance and should not be overlooked. The diet of children inclined to be dyspeptic and to suffer from headache should be plain, wholesome, nutritious, and easily digested. It is not well to train children to depend upon digestives, such as pepsin and pancreatin, although occasionally their use may be necessary. The stomachs of children are greatly helped sometimes by the administration in small doses, before meals, of bitter tonics, such as chamomile, quassia, columba, gentian, or cascarilla, which are best given in the form of infusion or small doses of the fluid extract.

The exciting cause of a reflex headache should always be attacked. Eyes, ears, teeth, nose, pharynx, stomach, liver, or genital organs should receive therapeutic attention if necessary. The removal of adenoids has resulted in great benefit to children suffering from headache and inability to study or fix their attention. Some striking instances are also on record of headaches due

to decayed teeth, writers even going so far as to declare that these and visual defects are the most common causes of headache.

For hysterical or imitative headaches moral treatment and the improvement of the general condition of the patient by tonics, nutrients, good food, gymnastics, bathing, and out-door exercise will prove most beneficial.

Neuritic or rheumatic headaches should be treated with the salicylates, which are often usefully combined with small doses of bromides and iodides.

Of local applications for the relief of headache in children, the most important are the use of menthol, chloral and camphor, ointments of aconitia, hot, cold, or ethereal applications, galvanism, and head massage. Sinapisms to the back of the neck and hot or stimulating foot-baths are good old-fashioned remedies which may prove of great service.

HYSTERIA.

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Hysteria in children has probably existed always. Peugniez tells us that in an old fresco of Dominicain the painter represents a saint curing a child possessed of an evil spirit. The patient is not drawn from imagination, but from life, for he is in one of the classical attitudes of the grand attack. With arms extended in the position of the cross, eyes rolled upward, and trunk convulsed in opisthotonos, he exhibits the disease in one of its most common forms. It was only because of the ancient Hippocratic definition of hysteria, which attributed the great neurosis to disorders of the womb, that for such a long period it was not recognized or acknowledged before puberty. For two thousand years this error ruled the medical world, and had for a kindred error the belief that hysteria is not observed in men. Lepois was undoubtedly the first writer to note the frequency of hysteria in children. After his time scattered references to the subject appeared, but still the old pathology prevailed even to the time (1846) of Landouzy's treatise. Briquet's statistics in his classical monograph on hysteria inaugurated the modern epoch of scientific investigation which secured the recognition of this form of the disease. It is, however, to Charcot and the contemporary school of the Salpêtrière that we owe the most light upon this subject. In the masterly demonstration of hysteria in both sexes and at all ages given by this school we recognize for the first time the unity and individuality of this disease. Hysteria is henceforth no longer a vague label, of indeterminate value, for an incongruous mass of phenomena, seen exclusively in women, which most writers have by tacit agreement united to call "protean." Far from being changeable and indeterminable these phenomena are shown to be constant and subject to a strict arrangement: far from being confined to one sex or age or country, they are shown to be distributed well-nigh universally; and far from being typical only in the adult female they are seen probably nowhere to more advantage than in children.

In addition to the writings of Charcot, we may make special mention of the thesis of Peugniez and the treatise of Gilles de la Tourette, to both of which we are indebted for invaluable information. Other notable theses are those of Clopatt d'Helsingfors and Mlle. H. Goldspiegel, quoted by Tourette. The annual contributions of Bourneville on hysteria, epilepsy, and idiocy are of great value. In the English language the most complete paper on hysteria in children is by Dr. Mills (*Keating's Cyclopædia of Diseases of Children*, vol. iv.). All these papers contain copious references and bibliographical lists, which, combined, bring the whole subject easily within the reach of the student.

It is our design in this paper to present a concise arrangement of this subject somewhat after the manner of the French school, and to illustrate it with our own clinical observations. We may premise, also, that while we hold hysteria to be a morbid entity, with a well-defined etiology, symptomatology,

and prognosis, we recognize that, as in the cases of so many other diseases, it is modified to some extent in childhood. It shall be our especial aim to emphasize this fact.

In the statistics of Briquet, hysteria in children occurred as follows in 87 cases:

In childhood (exact age not given)	31 cases,
At 5 years	3 "
From 6 to 7 years	6 "
" 7 to 8 "	11 "
" 8 to 9 "	6 "
" 9 to 10 "	9 "
" 10 to 11 "	4 "
" 11 to 12 "	17 "
	Total, 87 cases.

According to Briquet, this table constitutes one-fifth of his own observations in patients of all ages; hence 20 per cent. of his cases occurred in patients before puberty. This proportion is probably not exceeded in any other general nervous disease, unless it be in chorea. Briquet's patients seem to have been girls.

Cloplatt's statistics are the most complete up to date:

	Girls.	Boys.	Total.
In early childhood (exact age not given)	19	1	20
At 3 years	—	1	1
4 "	1	1	2
5 "	4	2	6
6 "	3	2	5
7 "	15	4	19
8 "	16	6	22
9 "	15	7	22
10 "	18	15	33
11 "	24	17	41
12 "	22	13	35
13 "	27	16	43
14 "	12	8	20
15 "	—	3	3
	176	96	272

According to this table, the disease is almost twice as frequent in girls as in boys. It increases almost steadily in frequency from the third year to the thirteenth.

Etiology.—The most common causes of hysteria in children are heredity, exhaustion and anæmia from acute disease, trauma, disturbing emotions, imitation and defective education.

The subject of heredity has two aspects according as the transmission is between similars or by transformation. By the first is meant transmission of the disease from an hysterical parent to an hysterical child; by the latter, transmission of hysteria from a parent suffering with some grave nervous disease, as epilepsy or insanity, to the child. The latter aspect, although not the more common, is far the more important of the two. This indirect heredity illustrates the kinship of many of the great neuroses, and demonstrates the necessity for a scientific investigation of remote causes. Briquet was the first to give this subject exhaustive treatment. According to his table, 351 hysterical patients had 1103 near relatives whose records were attainable; among these relatives were found 214 cases of hysteria, 13 of epilepsy, 16 of insanity, 1 of delirium tremens, 1 of paraplegia, 3 of somnambulism, 14 of convulsive diseases, and 10 of apoplexy. This is almost 25 per cent. of

cases of grave nervous disease in the immediate families of the patients. A "control" table of statistics based upon the cases of 167 non-hysterical women showed less than 3 per cent. of such nervous affections among 704 near relatives. Hence the percentage in the first class is more than eight times greater than in the latter.

Bourneville claims that alcoholism in the father is a not uncommon cause of hysteria in young children.

Children not infrequently present hysterical symptoms during the progress of, or convalescence from, acute disease. This is so especially in cases of the infectious diseases, and the complication may obscure the diagnosis in some cases not a little. The symptoms then observed are apt to be interparoxysmal. Other toxæmias also, such as those caused by lead, mercury, and alcohol, may produce hysteria, but to these causes children usually are not exposed.

Trauma, next to heredity, is most important as an exciting cause of hysteria, and the symptoms of the grand neuroses which it is especially apt to excite are among the most intractable and simulate most closely organic affections. These symptoms are paralysis, contracture, tremor, and persistent localized pain or tenderness. This cause is often conspicuous in the so-called neuroses following accidents on the railroad and by machinery; but in children very trifling accidents may cause hysterical phenomena.

Exciting or depressing emotions may provoke hysteria in children who are predisposed. Fright is one of the most common of these. Disappointment, chagrin, loss of near relatives have all acted thus. Sometimes vexations of a quite trifling character are sufficient. In former ages, more than at present, religious excitement claimed many victims for the grand neurosis. The chapters of this part of its history were often written in blood. Demonology, witchcraft, and possession were often but phases of hysteria complicated with superstition and fanaticism. The revolting epidemic of Salem witchcraft in this country was begun by some hysterical children in the kitchen of a New England parson. Imitation and suggestion were, and are, the potent factors in these epidemics. Somewhat similar but harmless epidemics, due to these causes, are still seen occasionally in schools and convents.

Finally, a defective or unwise education has much to do with the production of hysteria. The child that is constantly indulged, never corrected or controlled, taught to regard itself and its own wishes as always first, allowed to excite the emotions and imagination with fictitious literature, not disciplined to self-control, to self-denial, to duty and to the cultivation of the higher moral and intellectual faculties, is the child that is most apt to display the symptoms of hysteria. It must not be inferred, however, that hysteria is necessarily perverseness, selfishness, and simulation. This is a too common error, and one which unjustly attaches to hysteria a certain measure of opprobrium and contempt. It is true, rather, that in some of the finest minds a defective education leaves undeveloped the essential qualities of self-knowledge and self-control. This conduces to hysteria. On the other hand, as Briquet has pointed out, excessive severity and cruelty to children, as seen especially among the lower classes, may be the exciting causes of the disease.

Symptoms.—The symptoms of hysteria divide themselves naturally into two groups—(1) the Paroxysmal, and (2) the Interparoxysmal. We shall consider these in turn.

(1) Just as in epilepsy, so in hysteria, the convulsive phenomena too often attract the attention of the medical observer to the exclusion of even more significant symptoms. The hysterical paroxysm is regarded as in some sort

the essential element of the disease, the acme toward which all the other elements tend. Its bizarre character is no doubt the cause of this. As we shall see, however, the more permanent but less conspicuous symptoms of hysteria are often the more trustworthy, and sometimes the only, signs of the disease.

The hysteric fit has several grades, but as the less are included in the greater, being but modifications or abortive attacks, it is best to limit the description to the typical spell. This grand attack of hysteria has, rather unfortunately, been called hystero-epilepsy. This is a misnomer, because the fit has nothing of epilepsy about it. The term seems to signify a union of the two diseases, but such is not its true meaning, because such a union does not exist in the grand attack which we call hystero-epilepsy. It is hysteria—nothing more nor less. If a distinctive term were required, it would be better to speak of the attack as hysteria major, just as in epilepsy we distinguish the grand and the petit mal. The term hystero-epilepsy is unfortunate, moreover, because *both* diseases sometimes occur in the *same* patient. But in these cases the fits are always distinct. The French speak of these as cases of hystero-epilepsy with *separate crises.*

The hysterical paroxysm usually has prodromes. These especially are mental symptoms, and are noted and interpreted rather more easily in children than in adults. The child presents a change in disposition; this change is usually from gay and amiable to moody and choleric. The immediate exciting cause is sometimes evident, but not always. In the latter case the origin or point of departure of the fit may be in some mental state, some auto-suggestion, which we shall study later. In this mental prodrome the child shuns society, appears sad, melancholy, or irritable, and cannot be drawn readily from its self-absorption.

The paroxysm is preceded immediately by an aura. These auræ, as in epilepsy, are either sensory or motor. The most common is the sense of a ball rising in the throat, causing a feeling of suffocation. This may be quite alarming to the child, who clutches wildly at his throat in evident terror, crying that he cannot get his breath. This aura is called the *globus hystericus.* Another, equally characteristic, is the cephalic aura. This consists of loud bruits, or beating, throbbing, and hissing sounds in the ears; of acute pain, sometimes as of a nail driven into the head, hence called *clavus;* and of dimness of vision, and even vertigo. Other common auræ are the ovarian and the testicular. Ovarian tenderness not uncommonly precedes the fits. This may be spontaneous in women rather than in little girls. We have observed one case in which the patient called the physician's attention to ovarian pain, which proved to be only the precursor of an hysterical fit. Most frequently this ovarian tenderness may be elicited by pressure, and thus in confirmed cases the attack may be elicited by simply pressing firmly on the ovary. The aura, once started, seems in these cases to set going the whole associated mechanism of the fit. Similar results are claimed in boys by pressure on the testicles.

Immediately after the aura the fit proper begins. It is customary, for convenience of description, to divide this into periods. The French school observes four of these: first, the epileptoid period; second, the period of grand movements; third, the period of passionate expression; fourth, the period of delirium. We have convinced ourselves in our own clinical observations of the general accuracy of this division, but think, with Peugniez, that the third period is most likely to be wanting in the cases of children.

The first (or epileptoid) period may closely simulate true epilepsy, with which, however, it has no identity in any respect. It begins with a tonic stage, in which the patient usually lies supine with the limbs extended and rigid,

but with fingers and toes flexed. Deviation of the eyes is conspicuous; usually there is lateral conjugate deviation, the eyes being rolled slowly either to the right or left; in some cases, however, as in the one to be reported later in this paper, convergent deviation occurs. The teeth are held forcibly together, the breath is heavy and slow, then rapid, the neck is swollen (more so than in epilepsy), and the face is suffused. The heart's action is already becoming rapid. Sensation is usually blunted, and even abolished in some areas. The conjunctival reflex, however, is usually preserved in this stage. Consciousness is obtunded, and even lost in some cases, but in our observation consciousness is not affected so profoundly as in epilepsy. The tonic phase gives place rapidly to the clonic. The muscles of the face, trunk, and extremities begin to tremble, and then to be agitated with a succession of shocks. During this, or even during the preceding stage, the patient may turn over on his side or even precipitate himself from the bed. This clonic stage ends usually rather abruptly with a long-drawn breath, and is succeeded by a brief period of repose, during which the patient lies with closed eyes as if asleep.

The second and third periods of grand and passionate movements have not been observed so commonly by English and American writers, possibly because they have not studied these cases so methodically as the French. We have no doubt of the importance of the second period, especially in the cases of boys and girls. It explains many bizarre co-ordinate movements in children which exist sometimes as unsuspected abortive or atypical cases of hysteria. This period of grand movements begins abruptly. The patient throws himself into many and curious attitudes. Among the most common of these is the position of extreme opisthotonos, in which he rests upon his head and feet, which are at the ends of an arc of a circle. Other movements, too numerous and complicated to describe here, occur. Some of these have received special names, as the movement of salaam. Some of these movements are quite complex and apparently purposive, and may be elaborately automatic. These are more common in confirmed cases, and are probably the product of suggestion and auto-suggestion. They may persist, we believe, as isolated phenomena sometimes, or as a kind of abortive attack. Charcot calls these phenomena "*clownism.*" We shall narrate a case briefly in this paper.

The third, or period of passionate movements, is the least common in children. We do not, in fact, quite see the necessity for this subdivision, because these movements naturally grow out of those of the second period, with which, in fact, they are sometimes blended and confused. They are still more complex movements, or rather expressions of passions, and as such are not common in children, in whom passions are not yet elaborated, and such as do exist receive simple expression. In these passionate moods the patients betray fear, anger, resentment, etc.; and it is notable that if they attack they usually attack some one whom they dislike. We recall the case of a colored girl (in whose race hysteria major is not uncommon) who in this period of the grand attack struck savagely a fellow servant, with whom she had had a quarrel a short time before. These passionate movements, in fact, are always the expression of some pre-existent mental state, which persists as a mental picture—or "hallucination," as the French say.

The fourth and closing period of the convulsive attack is the period of delirium so-called. This delirium, well portrayed in children and young persons, is also the expression of a mental state, which is usually reproduced in every succeeding fit in the same patient. This mental state is one usually of fear and sadness, so that the period of delirium is characterized by tears, sobs,

cries, incoherent pleading, and appeal. These subside gradually and the attack is finished.

These grand attacks may be complicated with somnambulism and catalepsy, and they may present various atypical and abortive forms, such as choreiform movements.

Somnambulism has several traits that ally it to the hysterical status. In it we see a profound unconsciousness and abolition of will-power, leaving the patient under the influence of dreams and hallucinations, and extraordinarily susceptible to suggestions from without. A somnambulistic state has been observed sometimes as a complication of the hysterical paroxysm or as a post-paroxysmal phenomenon. Profound lethargy also supervenes sometimes in the fourth period. Catalepsy is another psychosis, which, while not essentially hysterical, has yet something in its nature that affiliates it with hysteria. Cataleptoid symptoms are not uncommonly seen in various periods of the grand attack, for they are not confined to any one period. They may be elicited sometimes by suggestion. We have done this in the tonic stage of the epileptoid period by elevating the patient's arms, and thereby have suspended the fit temporarily or even suggested a new turn in it.

Among the most interesting products of hysteria are the cases of so-called "chorea major." This is another misnomer, for which the Germans especially are responsible. This chorea major has nothing choreic about it; it is entirely hysterical. To understand its true position among the hysterical symptoms we may recall what was said above—viz. that the grand attacks may present various atypical forms. As Peugniez has shown, the attacks are not always complete. One period alone may appear, having an exaggerated development and leaving the other periods in the shade. Sometimes merely an aura, as the globus, is felt, and the attack aborts. In other cases the period of delirium, with tumultuous emotions, has such a large place as to appear to constitute the whole attack. Thus we believe it is in some cases with the period of grand movements. These movements become stereotyped as it were on the child's brain at the moment of the extreme susceptibility or "suggestibility" that characterizes him at this crisis. They become further developed, in successive fits or even between fits, into most extraordinary combinations of movements and cries. These movements are sometimes apparently purposive, sometimes of the nature of an acquired dexterity or trick, or, again, they may be most elaborately automatic, the patient's will and personality seeming to have nothing to do with them. These complex movements may be propagated readily to others, and thus they may give rise to epidemics in schools and religious communities which resemble the dancing manias of the Middle Ages. The writer saw and recorded one such case in a boy, in whom there was an elaborate syndrome of spasm, rotation, and catalepsy, undoubtedly hysterical in origin, and which was cured by a slight operation on the foreskin.[1]

(2) The interparoxysmal symptoms of hysteria, which form the second main group, are even more important than those of the paroxysm itself, for upon them must often depend the diagnosis of the disease from grave organic affections. Their study is too often neglected. They are the permanent markings of hysteria, and hence have been called the *stigmata.* These stigmata are sensory, motor, visceral, mental, and nutritional, and may be considered here in the order named.

The changes in sensation are varied in hysteria, but some of them are almost always present. Hyperæsthesia and hyperalgesia are common. The

[1] For a full discussion of the history of this phase of the subject see Richer's *Études Cliniques sur l'Hystero-Épilepsie,* Paris, 1881.

former is usually distributed in a characteristic way, and gives origin to the well-known hysterogenous zones. These zones are points or areas on the skin, pressure on which is usually painful and may excite the manifestation of other hysterical symptoms, especially the convulsion. This acute sensitiveness, however, does not appear to be confined entirely to the skin, but to include the subjacent organs, as for instance, the ovaries. The most common of these hysterogenous points in our observation are over the ovaries and at points along the spine. Others describe them as in the testicles, at the juncture of the ribs to the sternum, and at other points on the trunk. Pressure on a hysterogenous zone is a common means of exciting the convulsion of hysteria major, and when at its height pressure on the same region will often stop it. Hyperalgesia exists as various forms of neuralgia: some of these are the accompaniments especially of traumatic hysteria. We had such a case under observation in which pain at a circumscribed area in the dorsal spine in a girl, following a fall, simulated the early stage of spinal caries. This case occurred in the Home for Crippled Children, and the diagnosis was so uncertain for a time that the child was put in a plaster jacket. This seemed to make a beneficial mental impression, and the patient recovered rapidly. Among these traumatic cases that simulate organic disease are those in which the hyperalgesia becomes fixed in one of the joints, as the hip or knee.

Anæsthesia is one of the most important stigmata of hysteria. So common is it that it is doubtful if it is ever entirely absent in pronounced cases, and yet so little observed is it that even the patient himself is often ignorant of its presence. It may be very profound, and accompanied with coldness and vasomotor changes in the part. During the dancing manias and religious crazes of the Middle Ages and later, it was observed that a pin-stick would not bleed. This was a mark of especially evil augury to superstitious minds during some of the witchcraft plagues. It is now one of the best-recognized marks of hysteria. The distribution of the anæsthesia varies. One of the most common types is hemianæsthesia. This extends from the top of the head to the sole of the foot, and is often accompanied with anæsthesia of the special senses —sight, hearing, taste and smell—and of the mucous membranes. Another type is the distribution in geometrical figures, in which case the patient has areas of anæsthesia of various shapes and sizes scattered over the body. Still another is the monoanæsthetic type, in which an area of anæsthesia covers the arm and hand like a gauntlet or the leg and foot like a stocking. This latter distribution is often accompanied with paralysis of the member. This association with paralysis and the peculiar sharp demarcation of the anæsthesia at right angles to the long diameter of the limb serve to characterize this form very clearly. The hemianæsthesia of hysteria sometimes displays a peculiar phenomenon called transfer. Under the influence of some external agent, as electricity or a magnet, or even by suggestion or auto-suggestion, the anæsthesia passes from one side to the other. This change, however, is usually of short duration, for, as a rule, the affection soon returns to its first seat.

The affection of the special senses is often marked in hysterical hemianæsthesia. There may be hemianopsia toward the anæsthetic side, and deafness and loss of taste and smell on the same side. The most significant changes are in the eyes. First of these in importance is the concentric narrowing of the visual field. In the normal eye the visual field is not extended equally in all directions, being widest toward the temporal side, next toward the lower segment, next toward the higher segment, and least extended toward the nasal side. In the hysterical patient these relative proportions are apt to be maintained, the centre of the normal field being the centre of the abnormal

one, but the field itself is very notably contracted. In some cases, however, the relative proportions are not maintained, the contracted field being a round or oval area around the normal centre. This contracted field may be very small in some patients. Another significant change is in the perception of colors. In the normal eye the fields for colors are not the same. The widest field is for blue, then come the fields for yellow, red, green, and violet in the order named, violet having the smallest field. These fields for color are practically concentric. In the hysteric eye the violet field disappears first, being "squeezed out at the centre," as some one has expressed it. Then the other fields contract gradually and disappear in the order named, with the important exception that the red usurps the place of the blue field—*i. e.* it becomes the widest and the last to disappear. In fact, red is a very persistent color-perception in the hysteric, and is supposed by some French observers to play a part in the hallucinations and mental states of these patients. Other affections of the eye are amblyopia in various grades, and the curious phenomenon known as monocular diplopia or polyopia, in which the patient sees with one eye two or more images of the same object.

The motor symptoms of hysteria are of two orders: those that depend upon the absence of function, and those that characterize its perversion. Paralysis is of the first order, and contracture and tremor of the second. As Richer has pointed out, these disorders of motility are very apt to appear as isolated phenomena in juvenile hysteria, and sometimes at a very early age.

Hysterical paralyses present a variety of forms, but these forms are not as significant as their mode of onset, their clinical history, and their termination. The most common are hemiplegia, paraplegia, and monoplegia. Very frequently the paralyzed part is also anæsthetic—a very uncommon phenomenon in similar paralyses due to central nervous disease. In some cases there is no anæsthesia. Paraplegia is more common in children and young persons than hemiplegia. In hysterical hemiplegia the face often escapes; but if the face be invaded, it is more frequently some of the eye-muscles that are involved, in the form not of a paresis but of a blepharospasm. The paralyzed limbs may be flaccid or spastic. The onset of these paralyses usually is sudden. Their most common causes are trauma, emotion, and the hysterical fit. In the case of a young woman observed by the writer a paraplegia developed brusquely during a highly emotional love scene. In one of Bourneville's cases a paraplegia followed a grand attack of convulsions. During the paralysis the convulsions ceased, but after it disappeared they returned. The duration of these paralyses varies, but not infrequently they disappear as suddenly as they come, and sometimes as a result of mental impression. In the above case observed by the writer the faradic current cured the disease promptly. Sometimes a paralysis suddenly quits one limb or group of muscles and appears in another, as in the transfer scene in hemianæsthesia.

A peculiar form of hysterical paralysis is loss of power of co-ordination—the so-called *astasia-abasia*.

The most common contractures in hysteria in children are as follows: partial or complete contracture of a limb, intermittent torticollis, spasm of the orbicular muscle, and paraplegic contracture. The position assumed by the contractured limb varies according as the contracture occurs in the arm or leg: in the case of the arm the limb is usually flexed, while in the case of the paraplegic form the limb is extended, the foot being in the position of plantar flexion. The hysterical contracture may be very persistent, enduring for years. In childhood, as Richer observes, the contracture may appear, disappear, and

reappear with a sort of periodicity; in other cases it may pass from one seat to another. The causes of contracture are the same as those of paralysis.

Tremor is a rather rare motor disorder in hysteria, and is more common in adults than in children. It may be caused by trauma, but it occurs sometimes spontaneously. It generally presents the type described by Rendu of a rather fine tremor increased by voluntary movement.

The visceral and internal disorders of hysteria are numerous and quite important. We prefer to consider them here as a separate class, although some authorities include them under disorders of motility. Among the most common is aphonia, which as an affection of the larynx may be included here. It is caused most frequently by emotion, and is sometimes an isolated symptom. It may be complete, but more frequently the voice is not entirely lost, but only sinks to a whisper. It may appear and disappear suddenly.

Rapid respiration is seen sometimes in hysteria, and may confuse the diagnosis, because it suggests some affection of the lungs or heart. It is a rather rare symptom, and is probably more common in adults than in children. It presents the superior costal type of breathing, and the respirations may be as rapid as seventy to the minute. Dyspnœa is not present, nor any acceleration of the heart, as a rule. The only typical case of this affection seen by the writer occurred in a young woman during a long convalescence from a serious surgical operation.

Hysterical anorexia and vomiting are occasionally seen, and may constitute the most serious symptoms of the disease. They may bring the patient to the verge of the grave; in fact, in a few cases they have actually caused death. The vomiting is of a peculiar type which may serve to distinguish it. It is caused usually by a spasmodic movement of the œsophagus, by which the food is regurgitated without having entered the stomach. This has been called *œsophagismus*. In extreme cases this spasm continues at intervals without the ingestion of food, as in a case seen by the writer and reported elsewhere, in which the patient regurgitated only a frothy saliva. She kept a napkin constantly under her chin as she lay in bed, to receive the ejecta. She was emaciated to an extreme degree. In her case the symptom was caused by the shock produced by swallowing supposed poison accidentally.

Paresis of the intestine, causing immense dilatation of the tube and consequent distention of the abdomen, is seen occasionally in hysteria.

Affections of the bladder are not uncommon. Hysterical ischuria and painful tenesmus are observed, the latter, especially in women, being associated with a vaginismus. In young girls this is rare.

The consideration of the mental stigmata of hysteria has been reserved for this place, because, while these stigmata are the very first in importance, and constitute really the essentials of the disease, they can best be described after the sensory, motor, and visceral disorders which they serve to interpret. Hysteria is a psychosis. Without a study of the disease from this standpoint it is futile to attempt to understand it. But this subject is deep, complex, and, to some, repellant. Moreover, we have space here only to indicate its outlines.[1] It is necessary first to reject the idea that the hysterical child is a simulator and a liar. It has been a too common error, due to the writings of Legrand du Saull and others, to confuse the mental stigmata of hysteria with those of imbecility, degeneracy, and moral perversity. Hysteria and degeneracy are distinct, and, while the two may coexist in the same patient, just as may hysteria and epilepsy or hysteria and tabes, it is inexcusable to confound

[1] An early paper by the writer on "Hysteria—A Study in Psychology" was an attempt to state this aspect of the subject. (See *Am. Jour. of Nervous and Ment. Dis.*, Oct., 1883).

them. We must expect and search for distinct and characteristic mental stigmata in hysteria, and we believe, with Gilles de la Tourette, that such exist and may be recognized. With this author we recognize a mental impressionability, a proneness to take and act upon suggestions, as the real characteristic of hysteria. But even more than he, we would insist upon the hysterical automatism, in which there seems to be a dissociation of the higher mental faculties, as the will and intellect, from the lower emotional and impulsive states. This dissociation of mental faculties is more apparent than real: a more exact statement would be, that the hysterical child reacts to a morbid association of ideas, which permits it to develop the various physical stigmata. It is of first importance to recognize this, because by the proper use of suggestion—*i. e.*, education—much can be done to counteract the effects of this evil "dislocation" of the mental faculties. Suggestions come to the hysterical child either from without or from within; they doubtless, by the law of association of ideas, tend to form in each successive grand attack a more complicated web. Hence it is that many of the physical stigmata—paralysis, anæsthesia, etc.—either originate in or are aggravated by a seizure. Suggestions from

FIG. 1.



Case of Hysteria—(Harriet B——). First stage under Hypnotism.

without, as by trauma, moral shock, etc., act often between or independent of the paroxysms. Sometimes in children the paroxysm aborts, and there may be a true "psychical equivalent" (as in epilepsy), in which some of the most astounding of the hysterical combinations may appear. In children, too, the attack may pass off in some of the psychical prodromes, but these prodromes

may be followed by the dreamlike or delirious states of the fourth period. To these dreamlike states and states of reverie, as well as to their congeners, the nightmares and night-terrors not uncommon in hysterical children, Tourette justly attaches great importance. They influence remarkably the mental state between the attacks, as well as the physical stigmata. The auto-suggestion in traumatic cases is often reinforced by these dreams and nightmares.

Changes in nutrition are not marked or characteristic in hysteria. It is commonly said that anæmia is observed, but this is not in any sense characteristic, but only a result of the anorexia which is sometimes present. In other words, it is only an anæmia from malnutrition. The normal hysterical patient between paroxysms, unless anæmic, does not present changes in the blood. The observation of the ancient writers, that the blood would not flow freely from an hysterical patient, was correct, but the fact depended upon alteration in the vessels of an anæsthetic limb, and not upon any alteration in the blood. According to the table prepared by Gilles de la Tourette, the proportion of red blood-corpuscles, of hæmoglobin, and of urea in the blood of hysterical patients is practically normal. During and after the paroxysm it is probable that some transient alteration would be found.

The following case, from the writer's clinic in the Philadelphia Hospital, illustrates some of the foregoing descriptions:

Harriet B——, aged seventeen, English. The patient has a history from early childhood of headaches and fainting-spells. At twelve years she was severely burned

FIG. 2.

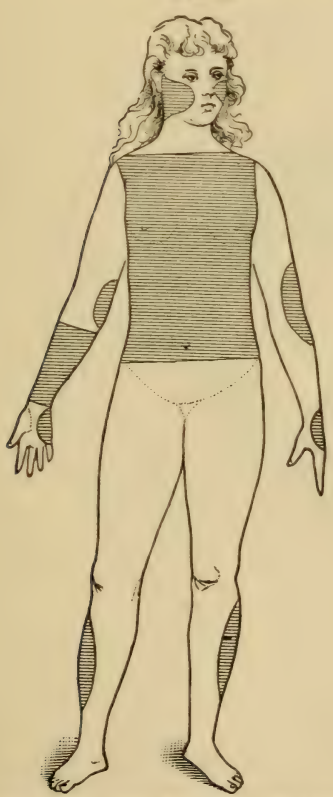
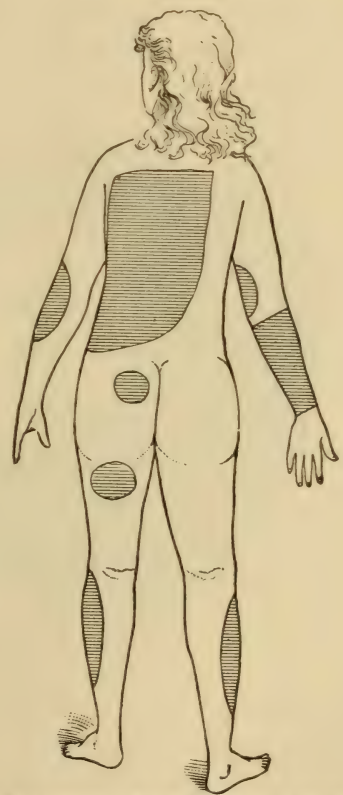


FIG. 3.



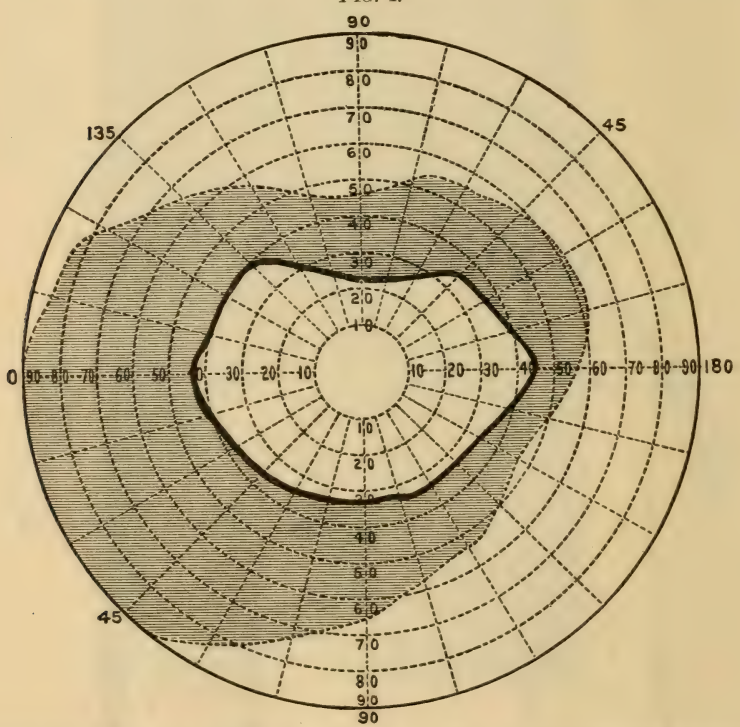
Anæsthesia in Geometrical Figures. (From author's case of hysteria in a girl, drawn by Dr. Riesman.)

about her body and limbs by her dress catching fire. She had her first fit at about fourteen under the following circumstances: A week before the attack she had slept with a very sick relative who was raving in a wild delirium all night. After returning home she constantly talked of this experience, which had evidently made a deep impression on her mind. On the night on which the fit occurred her father had stayed with the same relative until a very late hour, and then, going home, knocked on his daughter's door and awakened her. The child opened the door, was much frightened, and fell to the floor in a violent fit. Thereafter for a while she had as many as from nine to fourteen seizures a day. A physician who saw her in one of these said she was hysterical, and stopped the fit by slapping her in the face with a wet towel. Some of the seizures were nocturnal.

On admission the patient was observed to be a tall, well-developed girl, with a marked English accent.[1] She had many scars due to extensive burns. (These happened some years before her first convulsion). On the fifth day after admission she had a grand attack, lasting about twenty minutes; it came on spontaneously. She uttered a loud wailing cry for a minute or two, then became motionless in tonic spasm, with the eyes rolled up and respiration suspended. Then there was bilateral squint and extreme dilatation of the pupils. The period of tonic spasm was succeeded suddenly by one of slight clonic movements, complicated with spells of crying, sobbing, and choking. The patient was evidently conscious during part of the attack. During subsequent attacks she exhibited grand and passionate movements, and the fit was sometimes followed by a lethargic state. She can be thrown into one of these seizures by causing her to gaze fixedly at an object held before her, as, for instance, a lead-pencil.

The patient was found to have hysterogenous zones over the ovaries and over the upper dorsal spine. Pressure on these produces an attack as follows: The patient becomes rigid, with some flexion of the elbows and knees. The eyes become suffused, the face

FIG. 4.



Contraction of the Visual Fields in Hysteria. Field of O. S. (From author's case; drawn by Dr. Riesman.)

[1] This case furnishes a commentary on the claims of some English writers that hysteria, as described in France, does not exist in England. This patient is a typical English girl, born in Birmingham, and drops her *h*'s unmistakably. Yet she exhibits the grand attack as perfectly as though she were in La Salpêtrière.

The Editor of "An American Text-Book of Practice."

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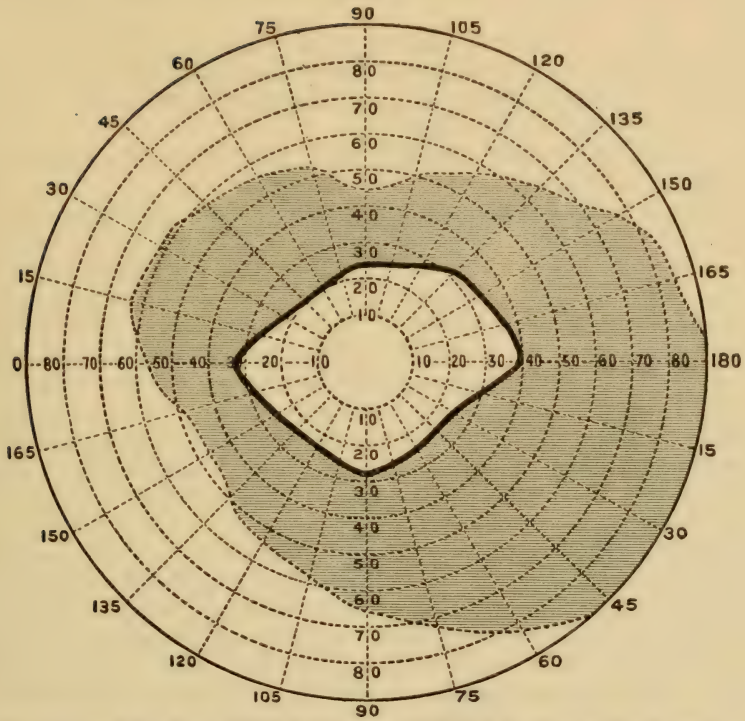
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FIG. 5.



Contraction of the Visual Fields in Hysteria. Field of O. D. (From author's case.)

flushed, and a rapt expression appears. The breathing is hurried and the pulse rapid. The eyes converge in internal strabismus and the pupils dilate. The arms may be placed in any position, and remain fixed in true cataleptoid rigidity (see Fig. 1). The hysterical symptoms are seemingly interrupted at times by the catalepsy. The tonic stage lasts for a long time. The clonic stage is of rather short duration, and is marked by tremors and clonic movements of not very wide range. Grand movements are observed in some attacks. The seizure ends in a paroxysm of tears and sobs. A lethargic state follows.

Between the paroxysms the patient has marked anæsthesia, both in geometric areas and in islets (see Figs. 2 and 3). Sensation is blunted in the buccal and lingual mucous membranes. There is no thermo-anæsthesia. There is some vasomotor weakness, shown by a bright erythematous flush extending for an inch or two around the mark of the æsthesiometre. The visual fields are narrowed concentrically (see Figs. 4 and 5), but the color fields are not modified in a typical way.

It is to be noted finally that this patient has had a few seizures strikingly like true epilepsy, in which she is unconscious, froths at the mouth, and bites her tongue. These have occurred mostly at night, and their exact nature therefore is difficult to be determined. But it is possible that the patient has "separate crises," *i. e.*, both hysteria and epilepsy.

Diagnosis.—In general terms it may be said that in the diagnosis of doubtful cases of hysteria the main reliance must be placed upon the presence of some of the permanent stigmata. It is frequently said that hysteria simulates all diseases, but the truth is that it simulates none exactly. The stigmata of the disease, if it is present, can usually be found.

Epilepsy is the disease most closely counterfeited by the grand attack. But this resemblance is seen in the first period only, the periods of grand movements and passionate attitudes not being seen in epilepsy. When the attack aborts in the first period, the likeness to epilepsy may be striking, and it may be necessary to base the diagnosis upon the stigmata. The possible asso-

ciation of the two diseases in one patient ("separate crises") must not be forgotten.

Paralysis due to organic disease may be simulated by hysteria. Paraplegia especially may be so simulated. The history of the case and the detection of other hysterical signs can usually determine the diagnosis. The same may be said of hysterical joint-disease.

The so-called "traumatic neuroses" are in large proportion hysterical, as a proper study of the stigmata will usually demonstrate.

The most common error is to confuse hysteria with degeneracy and moral perversity. It is commonly said that the hysterical patient has one or more of such syndromes as folie du doute, morbid scruples, mysophobia, agarophobia, impulse to set fire, to commit suicide, to make murderous assault, or that he is guilty of sexual perversions. It is needless to say that these are the stigmata of degeneracy, not of hysteria. The hysterical child is not a moral imbecile. While hysteria may coexist with degeneracy, as with numerous other morbid states, it is not part of it.

The various internal and visceral disorders, as hysterical breathing, anorexia, vomiting, phantom tumors, etc., may usually be diagnosticated by a process of exclusion, the history of the case, and the presence of one or more hysterical stigmata.

Treatment.—The treatment of hysteria in children must be partly moral and partly physical. Among the first we include especially education, and secondarily isolation. We have not space to discuss the subject of education, but after what we have said already of defective education as a cause of hysteria, and of the peculiar impressibility of the hysterical brain, it is enough simply to indicate the sovereign necessity for a sound moral and intellectual régime for these cases. Unfortunately, it is often difficult to procure it. In some cases, if a good training cannot be obtained permanently, the influence of an evil one may be combated temporarily by isolation. To remove the patient from unwholesome domestic surroundings is the first requisite for a cure.

Among the physical agents the most important for children are gymnastics, hydrotherapy, and vigorous tonic treatment. Gymnastics and hydrotherapy are much used by French practitioners, and with signal success. They probably act partly by their moral effects, both direct and indirect, as, for instance, by substituting wholesome impressions for morbid ones, and by divesting the mind of the unhealthy complexus of ideas which underlies the hysterical state. This vigorous restorative treatment, unless contraindicated by special conditions, is better adapted for hysterical children than is treatment by rest and by measures adapted to pamper and enervate them.

In anæmic states, secondary to anorexia, forced feeding and iron may be indicated. But anæmia, being a secondary condition, will usually improve, even without drugs, on the hygienic plan above suggested. As a rule, few if any drugs are indicated, but as it may be necessary to use some of them for their moral effect, the least injurious ought to be carefully selected. Bromides and sedatives ought to be avoided.

To abort or control the paroxysm a cold douche, pressure on a hysterogenous zone, a hypodermatic injection of morphine, or an emetic, have all been recommended and tried. Morphine, however, is not proper for these cases. In the cases of children suggestion skilfully used will sometimes abort paroxysms and diminish their frequency. The suggestion of an operation will sometimes act thus. Too much solicitude and too persistent holding and controlling the patient should be avoided.

CONVULSIONS.

By FREDERICK PETERSON, M. D.,

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Eclampsia is a term often used synonymously with convulsion. Eclampsia is a series of violent contractions of a limited number or of many muscles, clonic generally, sometimes mingled with more or less tonic spasm, paroxysmal in character, and accompanied, when severe and general, by loss of consciousness. Convulsions are to be looked upon not as a separate and distinct disease, but as merely a symptom of a great variety of morbid conditions affecting the most divers portions of the animal economy. The constant repetition of convulsive seizures at irregular intervals is often considered as a distinct disease, but, in the light of recent research, epilepsy too is now regarded merely as symptomatic of many pathological states which give rise to katabolic discharges in epileptogenetic centres.

But while eclampsia is only a symptom, it is one of so pronounced a character that it merits, and indeed requires, special consideration as regards its point of origin, etiology, nature, and treatment.

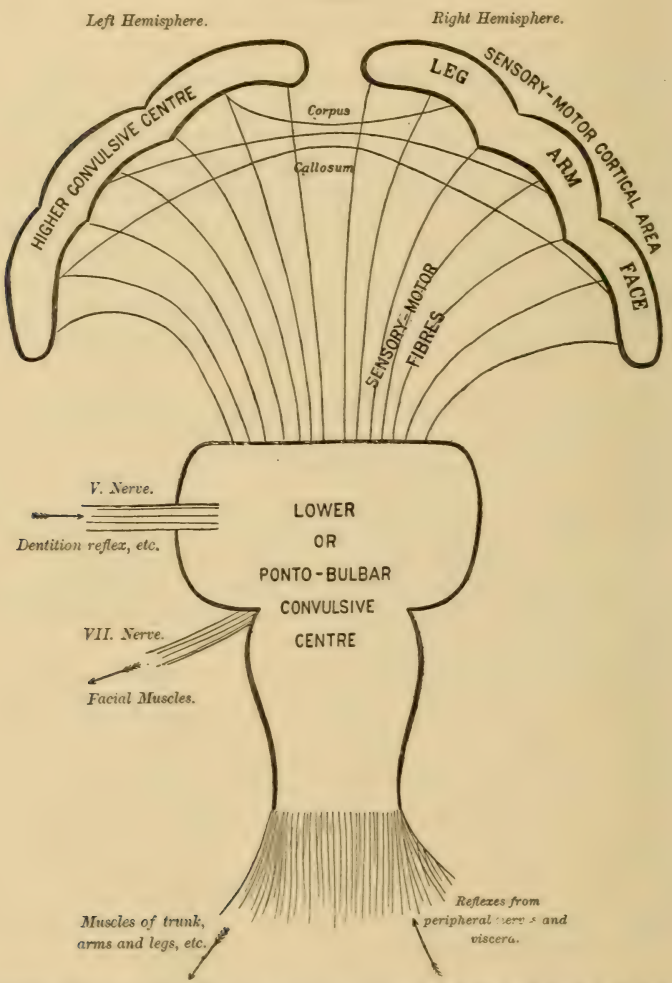
Convulsions occur at all periods of life, but are so common in infancy and childhood as a symptom of disturbance in nervous centres that, as West says, convulsions in children correspond with delirium in adults; and Trousseau goes even farther in saying that there are some children who have convulsions as easily as some persons have delirium or dreams. They are more common under the age of two years than at any other period of early life. Males are more frequently affected than females.

Seat of Origin of Eclampsia.—Convulsions, whether local or general, have their origin in katabolic discharges of nerve-cells, either in the cortex or at the base of the brain. J. Hughlings Jackson has taught that there are three levels from which such discharges may occur: from the cells of the ponto-bulbar region; from the Rolandic area; and from a level (purely speculative on his part) which he conceives to exist in the frontal lobes and to represent the highest control of sensory-motor functions. Whatever may be the merits of his highest-level theory, I believe that from a practical point of view we may consider eclampsia as originating either in the ponto-bulbar region or the Rolandic cortical area, and generally the latter. Jackson thinks laryngismus stridulus is a convulsive discharge from the ponto-bulbar region, while Semon believes it to be cortical. The former would also classify as ponto-bulbar convulsions the respiratory fits induced in animals by asphyxia, the seizures produced by convulsant poisons (such as nitrous oxide, curare, absinthe, camphor, and uræmia), and those resulting from injuries to the cord and sciatic nerve in guinea-pigs. Lately he has been modifying his earlier views, for now he intimates that, though the primary discharge in these cases occurs from the ponto-bulbar level, the higher centres may also at the same time be implicated by intermediation of the ascending sensory fibres. For my own part, I see no

reason why poisons, for instance, circulating in the blood may not discharge cortical centres simultaneously with ponto-bulbar centres. Whatever may be the ultimate idea attained as to the different levels, the seat of the discharge in convulsions is undoubtedly in the ganglion cells of the brain, and the molecular disturbance in these cells necessary to the discharge is determined either by direct irritation at these centres (from morbid states of the blood or vascular apparatus, trauma, neoplasms) or by indirect irritation (reflex).

I submit a diagram of the two chief epileptogenetic centres. (Fig. 1). There is no form of eclampsia generated from the ganglion cells in the spinal cord.

FIG. 1.



Showing, schematically, the two convulsive centres—one the cortical, the other the ponto-bulbar, and their relations and connections. They may be acted on directly by lesions of the centres themselves, or by vascular or blood states. They are more commonly acted upon reflexly by irritations conveyed along sensory fibres from remote parts.

Etiology.—Infants are always particularly liable to present the convulsive symptom, because of the incomplete state of development of the nervous system. An infant is a bundle of nerves and nerve-centres and reflexes in a state of great activity, prepared to receive, store up, and re-energize a worldful of new

impressions suddenly thrust upon it. While the nervous system of the adult has acquired the steadiness of long habit and has but to repair waste, that of the infant has all the delicacy and instability of newly-formed and highly-impressionable protoplasm, and, besides having to preside over the processes of repair, it must govern the growth of the whole organism. The lower centres at birth are more developed than the higher ones, and control is therefore much more imperfect; yet at the same time the healthy child rarely suffers from eclamptic seizures. It is the child with a hereditary neurotic and unstable nervous system, or with acquired nervous instability, that is prone to fall a victim to convulsions. Most authors are united in the belief that there is an inherited convulsive tendency, that some families are more predisposed to the development of convulsions in infancy than others, and that various neurotic conditions in the parents, such as drunkenness and epilepsy, may give origin to this tendency in their offspring. Rickets is one of the strongest predisposing causes, and the rickety condition is exceedingly common in children that suffer from convulsions, the coincidence occurring in 30 to 40 per cent. (Gee, Morris J. Lewis, and others). Anæmic conditions and exhaustion or general debility from any cause predispose to eclampsia.

The exciting causes are chiefly reflex, either from irritation in the fifth nerve (dentition) or in the visceral sensory distribution (gastro-intestinal disorders). Many of the exciting causes act directly upon the convulsive centres (febrile and toxæmic conditions). These are given as typical exciting causes. Whether the purely physiological condition of dentition is the sole exciting cause in the cases usually ascribed to that period, or whether there may not be other causes operative during this important epoch of early life, cannot always be definitely determined.

Improper feeding, over-feeding, and disturbances of digestion are very frequent causes of convulsions. Instances of improper feeding are not often so remarkable as one that came under my observation lately, where an infant of nine months was given a dinner of corned beef and cabbage. This was promptly followed by convulsions lasting seven hours, and these by a hemiplegia from a meningeal hæmorrhage. Gastro-intestinal disorders of all kinds are frequent precursors of convulsions. Worms no doubt often give rise to eclamptic symptoms, but not so commonly as is popularly believed. Convulsions complicate many of the acute infectious diseases, and are probably due to toxines of bacterial origin circulating in the blood. In the intermittent fever of children convulsions usually take the place of the chill. In certain districts it is common to speak of malarial eclampsia as a very fatal disorder. Convulsions complicate pneumonia occasionally, but rarely after the age of two years (Holt). Fever from any source is a prolific cause. Infants seem to be very susceptible to the influence of lead, convulsions sometimes following the therapeutic administration of this metal (Eustace Smith). The so-called "uræmic" conditions frequently give rise to convulsions, though it is well to remember that we do not know what poison in the blood is the exciting cause, and that we do know that urea itself is innocuous. In 3 to 5 per cent. of cases of whooping-cough eclampsia is a complication. Fright, terror, anger, burns, scalds, morbus cæruleus, earache, laryngeal irritations, and organic diseases of the brain and spinal cord are to be borne in mind as more or less frequent causes of infantile convulsions.

Pathology.—Often after death from convulsions no morbid changes are to be found at all in the central nervous system. Usually there are signs of death by asphyxia, such as engorgement of the meningeal and cerebral veins with dark blood. Sometimes the passive hyperæmia is so intense that effusion of blood

takes place, or œdema may be present. Some authors have described anæmic conditions of the brain after death from convulsions. The pathology is of course not obscure when actual organic foci of disease are discovered.

Outside of the central nervous system the most various pathological conditions are found at times in the heart, lungs, and abdominal viscera, this depending naturally upon the varying nature of the exciting cause.

Symptoms.—The simplest form of spasm is the respiratory spasm, known by several names, such as laryngismus stridulus, spasmodic croup, spasm of the glottis, child-crowing, and inward spasm. It is a local spasm, affecting generally the glottis, but in severe cases all of the respiratory muscles may take part in the morbid movement. In mild cases there is a slight stridulous or crowing sound made by the infant during inspiration through the spasmodically contracted glottis; in severe forms this sound becomes more intense, and the child may become pale or blue before the obstruction gives way. The paroxysms may appear at any time without warning, sleeping or waking, when being fed, or when laughing or crying: but the usual onset is at night. The attacks last from a few seconds to a few minutes, and terminate in a coughing or crying spell. Sometimes rigidity of the limbs, opisthotonos, or even general convulsions may accompany the laryngeal spasm. These seizures may occur once or several times in one night, and be repeated on following nights, the child being apparently well in the intervals.

In general convulsions there are at times prodromal symptoms, but more often none. The prodromal signs are restlessness, starting and crying in sleep, grinding of the teeth, twitchings of the face or extremities, flexions of the thumbs, and the like. These are often, however, unimportant. There is considerable variation in the extent and severity of eclampsia in children, from slight jerky movements of the head and face and carpo-pedal contractions, to a condition not differing from epileptic fits. Then in some of the graver cases there may be a cry; consciousness is lost; there is at first a tonic contraction, often not so long as in epilepsy: then follow vigorous clonic movements of the face, eyes, tongue, jaw, arms, hands, thighs, and legs, which gradually diminish in extent as the nerve-storm abates, until the child becomes wholly quiet, and remains dazed or in a deep sleep or stupor for some minutes or a half hour afterward. There may be frothing at the mouth. The tongue is sometimes caught between the teeth and bitten. The pupils may be contracted or dilated, and the face cyanosed or pale. There may be a single such attack, or the seizures may be repeated daily or innumerable times during a day or two, resembling the status epilepticus. Sometimes the convulsions may be limited to one side or one extremity, or to some particular part, as in respiratory spasm. The repetition of convulsions continuously limited to one side or one extremity would lead one to suspect a localized organic lesion in or about the motor cortex. Consciousness is not always lost in the milder types of infantile spasm. The temperature is generally normal in laryngismus stridulus, but more or less fever may accompany general convulsions, especially when prolonged and frequently repeated, as in the condition resembling status epilepticus (Morris J. Lewis suggests the term *status eclampticus* for this condition). Death may occur during a paroxysm, either from asphyxia or from unknown influences on cerebral centres. It is important, too, to remember that hæmorrhage may take place from the turgid meningeal vessels, as I have pointed out in another article in connection with the causation of the cerebral palsies of early life.

Prognosis.—Convulsions in children are always a symptom of great gravity. Life may be terminated in a single seizure. Yet many children become robust and healthy after passing through successive series of attacks. Naturally, our

prognosis must be governed by a knowledge of the exciting causes, and these are often very obscure. In children afflicted with convulsions during the first few days of life the probability of meningeal hæmorrhage from instrumental delivery or tedious labor is strong, since eclampsia is rare from other causes in infants under the age of one month. Hyperpyrexia is a very grave concomitant symptom. General convulsions associated with respiratory spasm, whooping-cough, and toxæmia of any kind are of serious import. The same is true when they follow upon wasting diseases, such as cholera infantum and diarrhœa. In the exanthemata convulsions at the onset are not so ominous as in the later stages, though in scarlatina they are dangerous indications at all times. The possibility of the recurrence of spasms in the form of epilepsy in later life should be borne in mind, for in nearly 10 per cent. of epileptics a history of infantile convulsions is found. It is probable that the convulsions are a symptom, more often than is generally supposed, of organic lesions in the brain, and that associated conditions, such as hemiparesis, hemiplegia, and mental defects, often escape recognition until later development of the child brings them into prominence. It is therefore well to remember that eclampsia may be associated with such states, as well as occasionally produce them, as noted above. When convulsions are ascertained to depend upon dyspepsia or other mild disorders of the alimentary canal, or to be symptomatic of rachitis, the results may not be so serious as under other circumstances, but the prognosis should always be guarded.

Diagnosis.—Convulsions occurring in children shortly after birth are probably due to injuries received during labor or to congenital pathological conditions (like heart disease or atelectasis), though reflex digestive disturbances are to be considered if organic causes can be excluded. In infants above six months of age gastro-intestinal troubles or disorders of dentition are to be regarded as most commonly the exciting cause, particularly in such cases as are predisposed by rickets or general debility. The temperature and pulse should be taken, for these often furnish indications as to the possible onset of some of the exanthemata. Symptoms of meningitis, pneumonia, and bronchitis, and eruptions should be looked for. The urine should be examined for albumin. The manner of origin and of onset, the order of the attack, and the presence of paresis or paralysis should be carefully inquired into.

Treatment.—The treatment of the convulsions of infancy and childhood depends, of course, to a great extent, upon the cause. But this cannot always be ascertained. Where there is reason to suspect organic brain disease, such as hæmorrhage, the treatment is much the same as in the adult—perfect quiet, cold applications to the head, relief of the bowels by injection, and the relief of the convulsions by chloroform inhalation and later by small doses of bromide of potassium. Should there be fever, the tepid half-bath, with cold ablutions and rubbing, should be frequently employed. When the eclampsia is due to some reflex disturbance, the warm bath is useful (96°–97° F.), and if there be colic or abdominal disorder a warm bath containing mustard should be employed. An overloaded stomach or an alimentary canal containing indigestible food may be relieved by one or two grains of calomel. A good emetic is a teaspoonful of syrup of ipecacuanha mixed with alum. Tickling the fauces should not be forgotten. If the child be at the age of dentition, and there be actual evidence of painful and swollen gums, these should be incised.

If called to a case of infantile convulsions where the cause seems to be wholly obscure, it may be laid down as a safe rule to give a warm (not a hot) bath, if, indeed, this has not already been done by the family, and to give an enema of five grains of chloral in a little warm starch-water, using a few drops of chloroform for inhalation while the chloral injection is being prepared and

while awaiting its effects. In recurrent convulsions medicines may be given in the intervals, and among these the bromide of potassium in doses of 3 to 5 grains for an infant six months old, and chloral 2 to 3 grains, stand pre-eminent as antispasmodics. The bromide should be continued for a few days after the convulsions have ceased, in order to prevent their repetition.

In laryngismus stridulus chloroform inhalation will always stop the paroxysm, though simpler means should be resorted to at first—viz., ammonia to the nose, slapping with a cold wet towel, tickling the fauces, and the like. In the interim between attacks the treatment of special exciting conditions should be carried out, as in infants suffering from general convulsions.

In all cases the diet should be regulated, and morbid states, such as rickets, diarrhœa, worms, dyspepsia, earache, and the like, be given appropriate treatment.

EPILEPSY.

By JAMES HENDRIE LLOYD, A. M., M. D.,

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Epilepsy is not a disease; it is a syndrome. By this is meant that it is a collection of symptoms or a comprehensive symptom-group. It was among the earliest recognized so-called diseases, because of its abrupt onset and dramatic features. Like many other symptom-groups of which the morbid anatomy was unknown, this one was made to include phenomena of a variety of distinct affections due to widely varying causes. With the growth of modern pathology these various disease-processes have been more and more carefully studied and differentiated. Hence one by one independent classes of epileptic, or *epileptoid*, affections have been separated from the main group. Thus the convulsions of hysteria major were first set aside. Later puerperal convulsions, or eclampsia, were defined. So, too, the convulsions of uræmia, of certain toxæmias, of infectious diseases, of degenerative processes such as general paresis, and those occurring in infancy, were demarcated. No one now would think of speaking of these fits as epileptic, and yet, except in hysteria, the convulsive crises, as well as some of the attendant sensory and psychic phenomena, are practically identical with those of epilepsy. Later still it was observed that in some cases the fits began always in one particular muscle or muscle-group, whence they radiated to a variable extent, sometimes persisting in only a few muscles or spreading to one limb or to one side, but in some cases extending to the whole body, involving consciousness only partially in the milder cases. These local fits were found to be due to a "discharge" from a limited area in the brain-cortex, determinable now by the principles of cerebral localization. This area of discharge is oftenest in the motor zone, but not always, because sometimes the first or "signal" symptom is sensory. This species of epilepsy is called "focal," or, after the writer who first described it, Jacksonian epilepsy. Not unfrequently such focal epilepsy is found to be due to a distinct local lesion, such as may be caused by trauma, by a neoplasm, or by some point of irritation or inflammation. Again, a large class of epileptics is associated with idiocy, arrest of development, or atrophy of the brain. The pathological processes underlying these are numerous, and some of them have not yet been clearly demonstrated.

Thus it is seen that the tendency of modern research is to demonstrate distinct pathological processes for the various diseases or conditions which have among their symptoms an occasional epileptic spasm. Hence there is left only a constantly narrowing group of epilepsies, of which the pathology is as yet unknown, and to which some writers illogically apply the terms "true" or "essential" epilepsy, or, still worse, *idiopathic* epilepsy. The author does not believe that epilepsy or any other disease is truly idiopathic, but he thinks, with Féré, that this group of essential epilepsies is one, not in which there is no pathology, but in which the pathology is unknown. But so long as this

group stands he recognizes that it will be desirable, even necessary, to give a clinical description of it in a text-book on practice, to state briefly the advances that have been made in its pathology, and especially to describe its proper treatment.

Etiology.—It follows from what has been said that the causes of the various forms of epilepsy differ. Focal epilepsy is usually dependent upon a local lesion, such as a trauma, a tumor, or a syphilitic or tubercular process. The causes of "essential" or vulgar epilepsy are often very problematical. It is the custom now to regard it as a manifestation of a degenerative process in the brain, dependent largely upon heredity or congenital imperfection. In this aspect it has its alliances with insanity on the one hand and with idiocy on the other. It is possible that some cases are the results of intra-uterine mishaps or diseases, or of injury, unobserved and unsuspected, at the time of birth. Others, again, may date from the insidious process of some infectious disease.[1] Alcoholism is an occasional, not a common, cause of confirmed epilepsy. It may act in the parents, however, to contribute to degenerative processes in the children, among the symptoms of which may be epilepsy.

Pathology.—Epilepsy, in its motor aspect, is an explosion of nerve-force from the brain-centres. But this is a crude and inadequate explanation of the disease-process. It does not explain all the phenomena, especially the loss of consciousness and the various psychical disorders. Bevan Lewis believes that the cells of the second layer of the brain-cortex undergo degeneration or "vacuolation"—that these cells are the sensory pole of a true sensori-motor arc, the motor pole being the large cells of the deeper layers. Hence the normal inhibition exerted by the sensory cells being destroyed, a periodical explosion of the motor cells occurs. It is needless to say that this is a mere theory.

Morbid Anatomy.—The gross lesions of focal epilepsy are usually easily recognized. Among the most common are tumors, especially in the motor region of the cortex. Next are wounds, causing either depressed fractures of the skull or localized inflammatory products, or both. Such wounds may be caused by blows on the head and by gun- and pistol-shots. Syphilitic lesions, as a localized pachymeningitis, may cause a focus of discharge. So may a tubercular deposit, often called massive tubercle. Focal discharges are sometimes, as the author has seen, among the earliest symptoms of tubercular meningitis. The gross deformities, such as porencephalon, and diffused processes, such as lobar sclerosis, which manifest themselves by idiocy and arrest of development, and are not unfrequently provocative of epileptic seizures, are not properly to be described here.

A number of diffused lesions have been reported as found in cases of chronic epilepsy. These are, as a rule, scleroses of different parts of the brain or bulb. Sclerosis of the Ammon's horn has attracted much attention and caused much debate. According to some, it is found in only 6 per cent. of brains examined, but, according to others, it is much more frequent. The facts of motor localization, as Féré says, do not lend countenance to the theory, and experiment shows that lesions of this part do not cause epilepsy; nevertheless, the observations are rather too frequent to be mere coincidents. With this author we may suppose that the induration of the cornu Ammonis is only a predominant localization of a more diffused lesion. Féré reports also plates of induration in various parts of the cortex and induration of the olivary bodies similar to that of the Ammon's horn. Chaslin claims to have found in brains of some of Féré's

[1] The infectious origin of epilepsy has lately been claimed by Marie (*Prog. Méd.*, 1887, No. 44), Lemoine (Ibid., 1888, No. 16), and by Veysset (Thesis, 1889, *De l'influence des maladies infectieuses sur le developpement de l'épilepsie*).

patients a diffused *neurogliar* sclerosis, a real gliosis—in other words, a proliferation of the neurogliar tissue of the brain, as distinct from a sclerosis of connective tissue.[1] The claim of Bevan Lewis that the distinctive lesion of epilepsy is a vacuolation of the cells of the second layer of the cortex has already been referred to. It still remains a vital point to be decided whether these various lesions are the causes or the effects of confirmed epilepsy.

Symptoms.—Adopting Féré's plan, we may divide the symptoms of epilepsy into four groups: (1) Sensory, (2) Motor, (3) Psychic, (4) Visceral. These blend in various ways in different cases; in fact, it may be said that no two cases of epilepsy are alike.

Sensory symptoms may precede or follow the fit, or both. The sensory *aura* is a very common signal or initial symptom. It may be a sense of numbness or tingling in one of the extremities, as in a finger or toe, or it may be a peculiar, indescribable sensation starting from the epigastrium and mounting to the head. This epigastric aura is perhaps the most common. When it reaches the head or neck, the patient usually loses consciousness and falls in the fit. Sometimes the aura is in one of the special senses, as flashes of light in the eyes or rumbling or other sounds in the ears. Auras of taste and smell are more rare. Occasionally hallucinations of sight are described, as an image of some person or thing, either agreeable or terrifying, appearing and advancing to the patient. The aura, whatever it is, is usually unvarying; that is, the same patient always experiences the same aura in succeeding fits. The sensory symptoms following the attack are less striking and variable. The most frequent is headache, which may persist for some hours or even a day. Sometimes the sensory symptoms constitute the whole of the attack, and may consist in a crisis resembling migraine. In fact, some authors teach that all migraine is an epileptoid affection, but of this there is not satisfactory proof. Certainly, ordinary migraine does not show a tendency to pass into motor epilepsy.

The motor symptoms of epilepsy are by far the most conspicuous, and so dominate the scene that they are apt to be regarded as the most important; but this is an error. They present great variety, and, for the sake of brevity, can best be described in some of their typical forms. The first visible motor symptom may be in the form of an aura; that is, a signal symptom recognized by the patient. This may coexist with or immediately follow a sensory aura, such as has already been described. It is usually a tonic or clonic movement of the muscles of one of the fingers or toes, or of the external muscles of the eyes, or of the muscles of the face or neck. This motor aura is especially likely to occur in the focal epilepsy referred to above. This slight initial spasm soon radiates to other muscles, then to the proximal parts if in a limb, then to the whole limb, then to the limbs of one side, and then, in severe cases, to the whole body. The first movement of the convulsed muscles is nearly always tonic or spastic, rapidly giving way to vibratory and clonic movements. In some milder cases or attacks of this focal epilepsy the movement may consist of merely a slight spastic, followed by a jerky, clonic convulsion in a very limited muscle-group. In the most severe of all forms of epilepsy, known as vulgar epilepsy or *grand mal*, the motor phenomena are about as follows: Almost instantly, with a very brief aura, or even without any warning whatever, the patient utters a peculiar startling cry and falls convulsed. This cry is probably part of the motor symptom-group, being rather the result of the forcible expulsion of air from the chest by the vice-like spasm of the respiratory muscles than the expression of emotion or other psychic states. When he falls

[1] For an exhaustive discussion of this whole subject see Féré's treatise. *Les Épilepsies et les épileptiques*, Paris, 1890, chap. xxx, p. 437.

the patient is in a general tonic or spastic stage. The pupils are dilated. The face, at first pale, rapidly becomes congested and cyanosed. The teeth are firmly set, the tongue probably caught between them. The fists are clenched, the limbs extended, the head often drawn forcibly to one side. In a few moments vibratory movements begin in the muscles of the eyes, face, and extremities. These vibrations soon increase in range, and they pass into clonic spasms, which gradually diminish and usually terminate in wider shock-like movements. While they endure bloody or unstained froth escapes from the mouth; the urine, and rarely the fæces, may be expelled. The patient often injures himself in his fall, besides biting his tongue. He is unconscious from the first moment, and sleeps heavily for many hours afterward. Exhaustion, even paralysis, of the convulsed muscles may follow the fit. Exhaustion and abolished knee-jerks are seen after these severe attacks especially. Paralysis in the previously convulsed muscles is more apt to occur after focal epilepsy, especially when this depends upon a destructive focus, such as trauma or tumor, in the brain.

The psychic symptoms of epilepsy are of the very first importance. It is too often the custom, unfortunately, to regard epilepsy as a mere motor disorder characterized only by a fit. There is nothing wider from the truth than this. Epilepsy, or that for which it stands, is much more than a fit. Its essential factor is probably a widespread degenerative process which involves not only the motor and sensory cortex, but also the higher intellectual spheres of the brain. Hence, as was recognized long ago, epilepsy has important relations to the mental health. The transient psychic disorders usually attending the convulsion, or following it, have already been noted. They consist of very fleeting mental states, which accompany the aura, such as confusion, possibly in some cases terror, or even rage, and which soon pass into unconsciousness. This unconsciousness lasts for a variable time, usually persisting as a deep sleep for some hours after the fit. But there are other and more important psychic phenomena. Not only loss of consciousness, but also stuporous and confusional states, as well as various forms of mental derangement, attests how comprehensive may be this degeneration. Among the most common of these derangements are episodes of fury with forgetfulness, mania, substituting or following the paroxysm, delusional ideas, moral perversions, coma, and chronic deterioration of the brain-faculties. Many years ago Morel, a French writer, described masked epilepsy (*épilepsie larvée*), in which the motor crisis is not apparent, but is replaced by an explosion of maniacal fury. This is perhaps an extreme doctrine if applied to the cases of persons who have never been known to have any of the motor disorders of epilepsy. But this variety is very similar to the now well-recognized substitutional attacks. These are episodes of confusion, forgetfulness, automatism, and even violence, taking the place of a motor seizure in a confirmed epileptic. They are called also psychical equivalents. Another mental disorder is mania, a dangerous complication. It may appear as a substitute for, or as a sequel of, a paroxysm. Delusions sometimes persist in the epileptic, which appear to have had their birth in the disordered brain just before or after a convulsion. Homicidal and suicidal impulses are sometimes displayed. The terminal dementia of epilepsy is a state of degeneration of the mental faculties. As was said above, no two epileptics are alike. Hence it is futile to attempt to classify this great array of psychoses into "prodromal," "post-paroxysmal," etc., as some have done. Each case must be studied by itself. Commonly, mental symptoms appear just before or after or substituting a paroxysm; in other words, they are part of the epileptic discharge. Where they seem to come independently of a fit, it is well to recollect that the motor discharge may have been so slight as to have been overlooked.

The great viscera are variously affected in epilepsy. Death has resulted from asphyxia due to the spasm of the chest-muscles, or even from rupture of the heart occurring during the tonic stage. Crises resembling angina pectoris, also peculiar spasmodic affections of the larynx, are sometimes epileptic in character. Nocturnal incontinence of urine, especially if persisting after early childhood, may excite a reasonable suspicion. Disorders of digestion not unfrequently persist for some days after a convulsion; these are chiefly nausea, vomiting, anorexia, constipation, or diarrhœa. Jaundice even has been seen. Post-paroxysmal albuminuria has been observed, but not constantly, as some have claimed. Glycosuria is exceptional. Visceral symptoms are quite prominent in some cases of petit mal; thus with slight dizziness and confusion there may be nausea or palpitation of the heart. In a very few cases hæmorrhage into the brain has been found as a result of a fit.

The nutrition is variously affected by the epileptic seizure. Loss of weight and alterations in the blood, such as diminution in the quantity of oxyhæmoglobin, have been observed and studied by Féré, Henocque, and others.

Epilepsy leaves its marks or *stigmata* upon the body of the patient. These are most conspicuous in chronic cases that have begun early in life, and hence in cases that are most distinctly degenerative in origin and course. Some of these somatic signs, in fact, are identical with those that are now well recognized in constitutional or hereditary types of insanity, or even in arrest of development. Among them are cranial and facial asymmetry; also other cranial and skeletal deformities. Such epileptics, on the whole, are of poor or even stunted development, although many exceptions to this rule occur. Defective development of teeth, external ears, and genital organs is sometimes noted. The epileptic facies has been described, but it is too often the evidence of bromidism rather than of disease.

Varieties.—There are many varieties of epilepsy. *Focal* epilepsy has already been described. *Petit mal* is often only a minor form of this: it consists in a momentary dazed or confusional state, with or without localized muscular movements. *Grand mal* also has been described. *Nocturnal* epilepsy is not distinct, except for the fact that the attacks occur during sleep: *somnial* epilepsy would be a better term, because the attacks occur really during sleep, whether this be during the day or night. Cases have preserved this type for many years. *Procursive* epilepsy derives its name from the fact that the patient runs for some distance before falling in the fit. *Masked* epilepsy, already referred to, is the type in which the sensory and motor symptoms are replaced by a psychosis. A very grave complication is the epileptic *status*. In this the patient passes rapidly from one convulsion into another. He is comatose, with high temperature, a weak pulse, and a stertorous respiration. In this condition he may die.

Diagnosis.—Epilepsy is to be distinguished especially from hysteria, from the convulsions of uræmia, and from those due to gross organic brain disease. It can be distinguished successfully from hysteria by the absence of the hysterical stigmata, which cannot be described here; by the history of the case, and by a careful comparison with a typical grand attack as described elsewhere. It can be distinguished from uræmia by the history of the case and by the absence of evidence of organic kidney changes. In gross brain disease the symptomatic epilepsy is often focal, although not always, and other symptoms, such as various forms of paralysis of motion and sensation, changes in the optic disks, vomiting, vertigo, and acute mental symptoms, together with the history of the case, assist in the diagnosis. In children a grave question sometimes arises as to the exact nature of a convulsion, especially if it has been repeated after

a comparatively long interval without apparent cause. Reflex epilepsies in children from teething, worms, constipation, etc., are not nearly so frequent as has been supposed. The great majority of infantile convulsions are caused by some infection of the blood, such as the poisons of scarlatina, measles, whooping-cough, etc., or the products of indigestion. Where no such cause exists, and especially when the convulsions are repeated at comparatively long intervals, the case ought to be recognized as serious, as threatening the formation of the epileptic habit, and it ought to be treated accordingly.

Prognosis.—In early exceptional cases, not caused by gross brain disease, it is possible that a cure may be obtained. For chronic epilepsy there is no cure. The more inveterate and severe the fits, the greater is the chance of mental complications and ultimate deterioration. This rule is not universal, however, because mental symptoms are due to obscure causes and may appear in mild cases. Patients with severe, if infrequent, attacks often lead a long and even useful life. The epileptic status is always dangerous to life. Brain-surgery has relieved focal cases due to gross lesions, but even in these cases relapses have occurred.

Treatment.—The treatment of epilepsy must be both hygienic and specific. It has long been observed that over-eating, over-sleeping, and a slothful life are especially injurious to epileptics. In young patients, who do not yet show the marks of chronicity and deterioration, it is important to regulate the habits and the daily life. Attention ought to be paid to the gastro-intestinal tract; over-eating and constipation must be guarded against. Radcliffe of England also cautions against over-sleeping as provocative of more frequent seizures. An overloaded bowel will undoubtedly act injuriously upon the epileptic. This is a matter of common observation in the Philadelphia Hospital among the epileptics and the epileptic insane. An idle life is, unfortunately, often forced upon the epileptic; he both shuns and is shunned because of his affliction. It were far better if he could be kept busy at some light and agreeable task. In private patients this need can and ought to be met. Finally, the well-recognized rules of personal hygiene, which cannot be given here in detail, ought never to be relaxed.

The indications for treatment supplied by the advanced pathology of epilepsy, given above, are several. Drugs which have, or are supposed to have, a restraining effect upon connective tissue or neurogliar proliferation ought to have a thorough trial. Iodide of potassium is the first of these in importance. The mercurial drugs may have a somewhat similar effect, as may also nitrate of silver. Arsenic and zinc salts are of doubtful utility. It is but reasonable to suppose that the peculiar action of these medicines will be exerted best in recent cases and in young persons. Certainly, every such case ought to have a thorough trial of the iodide of potassium. If time shall prove that this latter drug exerts a true alterative action upon the sclerotic processes seen in epilepsy, it will deserve, rather than the bromides, the title of a specific.

The bromides are undoubtedly the surest remedy for epilepsy, especially for controlling the fits in confirmed cases. That they are ever curative, even when given early in young patients, is at least doubtful. The writer has never seen them effect a cure. Some authorities advise heroic doses given until the patient is "bromidized." It is well to try this plan in early cases in the hope of eradicating the disease. In chronic cases bromide in any doses cannot cure, but it can reduce the number of seizures. It does this, however, at the cost of much depression, and in advanced cases, if given in large doses for a long time, it probably promotes some deterioration of the brain. Children bear large doses of the bromides well. Of the various salts, the potassium is rather

the most reliable, the sodium is least likely to disturb the stomach, and the ammonium is stimulating to an insignificant degree. The iodide of potassium can be given with any bromide salt.

Antipyrin has been tried with apparently good effect in epilepsy. It belongs strictly to the same class as the bromides—*i. e.* it is palliative rather than curative. Chloral hydrate may assist the bromides, especially in urgent cases like epileptic status.

Of other drugs, none deserve special mention except belladonna and nitrite of amyl. The former has value, but its unpleasant physiological action is much against it. The nitrite of amyl is of use in some case of petit mal to abort the crisis.

Surgery offers relief in many cases of focal epilepsy due to gross lesion of the brain or skull, such as tumor and fracture. The seat of an old fracture, or even suspected fracture, ought to be trephined if epilepsy supervenes. The principles of cerebral localization may indicate the seat of a lesion in obscure cases. Even in cases where no organic lesion has been discovered, excision of that part of the cortex which contains the focus of discharge has done good.[1] Trephining in cases of epileptic idiocy caused by brain atrophy, porencephalon, and other gross defects, should be condemned. It is not based upon scientific principles, and the results in the cases in which it has been done are disappointing, and they have often been fatal.

[1] See cases by Lloyd and Deaver, *Am. Jour. Med. Sci.*, Nov. 1888, and *Intern. Clinics*, vol. iii., 2d Ser. 1892.

CHOREA.

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Chorea minor, Chorea of Sydenham, or St. Vitus' Dance, is a functional nervous disease characterized by sudden rapid twitchings of any or all of the muscles of the body, by slight deficiency in the control of the muscles which twitch, and by mental irritability.

Description.—The *movements* produced by chorea are spasmodic, unexpected, and inimitable. They cannot be arrested by will for any length of time, but are much increased by attention, by excitement, or by any effort either to restrain them or to exercise the muscles involved. In the majority of the cases the movements are momentary and slight, and do not exhaust the patient. In a few most severe cases they are extended, violent, and continuous, endangering the patient's safety and even his life. These movements interfere greatly with voluntary acts, rendering them imperfect, awkward, excessive, or even impossible. When chorea is slight, such acts as dressing, writing, or playing the piano may reveal irregular motions not noticeable in a state of rest; and often it is this unusual awkwardness in the performance of these acts or nervousness which first attracts attention to the condition. When the disease is fully developed any movement involving fine co-ordination is impossible. While any muscle of the body may be involved in the choreic movements, it is more common to notice them in the extremities and face than in the muscles of the trunk. The facial muscles are frequently affected, and the child makes queer faces, especially while talking. The eyes are suddenly closed or opened; the mouth pouts; the tongue if protruded is seen to be affected, and may be suddenly withdrawn, or even be cut by an unexpected snapping together of the jaws; occasionally the laryngeal and respiratory muscles are affected, and noises are made in the throat. The neck is not as frequently affected as the shoulders, but the arms below the elbow are almost always involved, and irregular, awkward motions of the fingers are always seen or felt if the hands are held. While the trunk-muscles do not often appear to swell out in contraction, yet the entire body is uneasy, and frequent changes of posture are always to be seen. The legs below the knees are affected as often as the arms, but the thighs do not often twitch, and the patient is rarely seen to fall, though he may stagger in walking. These motions cease during sleep.

The *weakness* in the muscles affected may occasionally amount to paralysis, but this is rare. The awkwardness or ataxia is always noticeable. The disease might be supposed to be entirely muscular in its origin, were it not for the facts that it is very often unilateral and almost always associated with mental irritability. Hemichorea is about one-third as common as general chorea. In 474 cases of my own 169 were unilateral. It occurs on either side, and if the disease begins as a hemichorea it rarely becomes general. If it has once occurred as a hemichorea, it usually recurs as such.

The *mental irritability* is usually noticeable early in the disease. It may

be accompanied by inability to exert the mind continuously and by enfeebled ability and depression of spirits. The child frets and is easily irritated, is quarrelsome when previously of good temper, cannot be amused, and is said to be naughty when in reality it is unable to exercise self-control in a normal manner. It may act in a semi-imbecile manner, laughing too easily. It is always incapacitated for study. This mental excitement may interfere with sleep.

A child who is suffering from chorea is unusually pale, badly nourished, has little appetite, is constipated, passes but little urine, and that of high specific gravity, loaded with phosphates and urates. Very frequently, if examined, it will be found to have a loud systolic heart-murmur, which may be either functional and due to anæmia or organic and due to endocarditis. There is often obtained a history of muscular pains or of an attack of rheumatism preceding or coincident with the appearance of the chorea, and also of headache. There is usually diminution of the tendon reflexes and a hyperexcitability of the muscles to electrical stimulation. Temperature, pulse, and respiration are normal.

The disease appears suddenly sometimes after a fright, increases during the first two weeks, lasts for several weeks (ten is the average), and gradually subsides, but will probably recur after a year at the same season at which it first appeared.

This description applies to the majority of cases of chorea. There are exceptional cases which require mention.

In a few instances the motions are constant, excessive, and violent, so that the patient will be thrown off a chair or out of bed, and is liable to injure his limbs by their violent contact with objects. Unless these patients are kept asleep, they are soon worn out and may die of exhaustion.

In a few cases the mental irritation rises to the pitch of mania, and active delirium occasionally occurs in this form of the disease.

In some the weakness is so much more apparent than the twitching that the case impresses the observer as one of paralysis: this has been named the paralytic form. I have known a case of chorea to be mistaken for infantile spinal paralysis. Occasionally the twitching is less noticeable than the awkwardness, and were it not for the age of the patient and the absence of other symptoms the case might be thought to be one of locomotor ataxia.

In a few instances speech becomes affected early, and may be so indistinct that it cannot be understood: it is in these cases that grunting noises may be made. Sometimes nervous patients affected with twitching motions give vent to loud words unexpectedly, usually of a profane or obscene kind. This condition, known as coprolalia, is not choreic, but hysterical. So, too, is echolalia, in which the patient repeats the last word heard. Such patients often mimic motions and show other signs of hysteria.

Subcutaneous nodes, which are small, round, hard nodules appearing in many parts of the body, notably on the back and along the flexor surfaces of the extremities, are occasionally seen in choreic patients. They are to be regarded as evidence of rheumatism, and have no special relation to the chorea.

Duration of the Disease.—The duration of an attack of chorea is very variable in different cases. Sometimes the disease runs a rapid course, and terminates in recovery within a month; again it may continue for a year or more with varying degree of severity; occasionally it becomes chronic and lasts for years.

The large majority of cases of chorea last from six to ten weeks, and terminate in recovery; but there is always danger of a relapse, and the greater

number of the patients suffer from a second or third attack, which attack usually occurs at the same period of the year at which the first seizure occurred. I have treated a patient for seven successive years every spring, and have many cases on my books of fourth and fifth recurrences.

Death only occurs as an exception in children, though fatal cases in adults, especially when chorea complicates pregnancy, are not very rare. When a child dies of chorea it is because of exhaustion on account of the severity of the motions.

Etiology.—*Sex.*—Males are less liable to the development of chorea than females, the proportion being about 1 to 3. Of 466 cases of my own, 136 were males and 330 were females; of 436 cases collected by the Collective Investigation Committee of the British Medical Association in 1887,[1] 114 were males and 322 were females.

Age.—While chorea may occur at any age of life, instances having been reported both at birth and at the age of eighty-six, yet the large majority of cases appear between the fifth and fifteenth years of life. Table I. shows the age of onset in 467 cases under my own observation and in 436 cases tabulated in the report of the B. C. C.:

TABLE I.—*Age of Incidence of Chorea.*

Cases.	Under 3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16 to 20.	21 to 25.	26 to 30.	31 to 35.	36 to 40.	Over 40.
B. C. C. cases . .	2	1	3	15	25	20	43	46	49	42	41	39	20	71	10	2	1	1	6
Personal cases .	3	7	19	22	34	55	44	43	35	42	42	35	22	56	10	0	2	1	5
	5	8	22	37	59	75	87	89	84	84	83	74	42	127	20	2	3	2	11

Classes.—While children in all classes of the community may be attacked by chorea, a large majority of the cases are found to develop among the lower classes, especially among children living in tenement-houses under bad hygienic surroundings and subsisting upon poor and badly cooked food.

Season.—Several interesting investigations have been made with regard to the relation between atmospheric and climatic conditions and the development of chorea. An attempt has been made by Lewis to trace some relation between the occurrence of storms, between barometric changes, between changes in humidity of the atmosphere, and the occurrence of the onset of chorea. While it appears from the tracings upon his table (see Table II.) that there is some connection between the conditions of the weather and the development of rheumatism, and while there is undoubtedly a distinct tendency for chorea to prevail in certain climates at certain seasons of the year, yet no precise statements in regard to the influence of climatic changes upon the production of chorea can be made.

Weir Mitchell and Sinkler have called attention to the fact that chorea appears with greater frequency at certain periods of the year, notably during the spring. Table III., which compares the months of onset of 170 cases of Weir Mitchell and 409 of the author's, clearly shows that the largest number of cases begins in the spring.

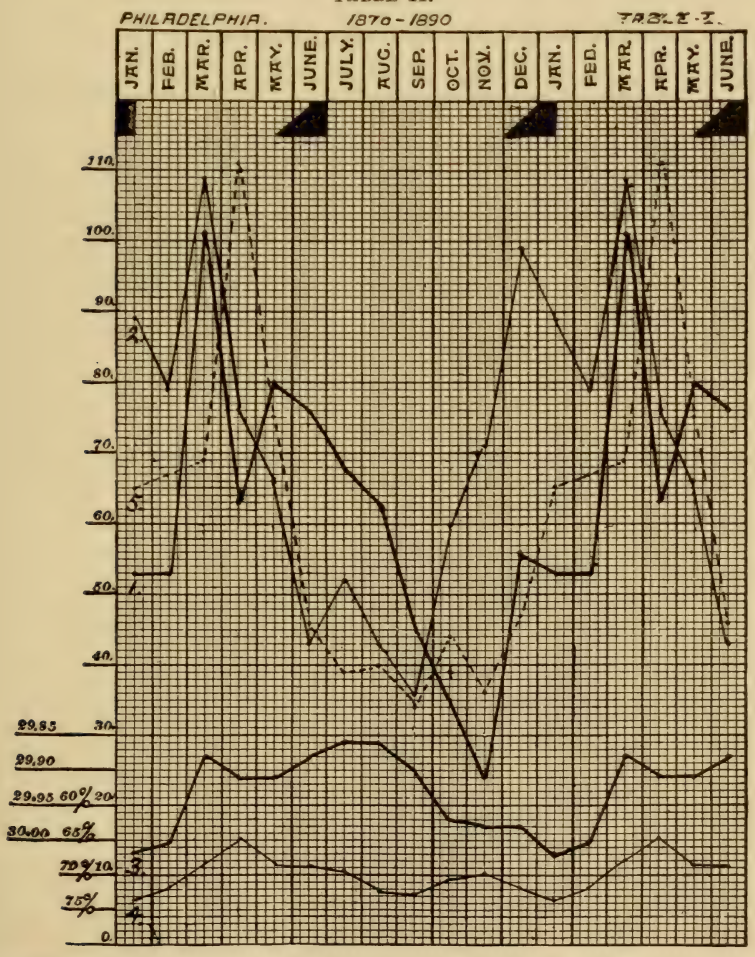
Relation of Rheumatism and Chorea.—For many years it has been admitted that there is an intimate relation between chorea and rheumatism. Many cases of chorea develop immediately after an attack of acute rheumatism, with or without accompanying endocardial complications. In many instances

[1] The results of this investigation are valuable, and will be referred to in the course of this article as the B. C. C., British Chorea Committee. (See *British Medical Journal*, Feb. 20, 1887.)

rheumatism and chorea appear alternately, one succeeding the other in some patients; in many cases they appear simultaneously. In Table IV. the relationship or coincidence of these diseases is displayed, and the large percentage of cases of chorea in which rheumatism has existed (26 per cent.) can not be ignored. The statement may be made that a certain poison in the blood, either of extraneous origin or internal development, under certain conditions, produces rheumatism or chorea or endocarditis. This poison may affect the joints or the nervous system or the heart, probably in accordance with the varying susceptibility of these organs in different individuals, and in many subjects it produces all three diseases at once.

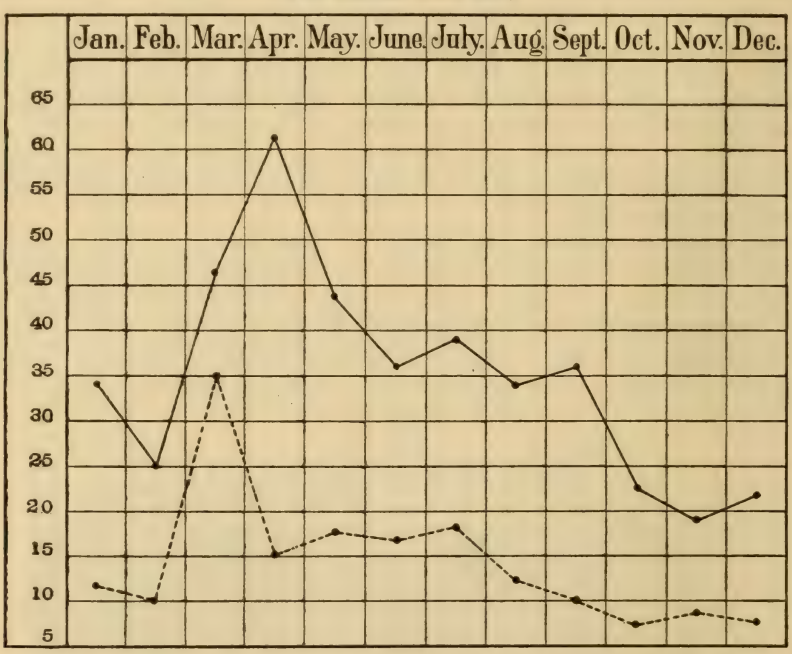
Some authors regard the existence of "growing pains" of an indefinite muscular character as sufficient evidence of rheumatism, and in the statistics here collected it has not always been possible to determine whether the pains called rheumatic were of this character. In my own cases I only consider those rheumatic in which a history of acute articular rheumatism occurring within three months of the onset of the chorea has been obtained.

TABLE II.



1. 717 separate attacks of chorea; 2. Storm-centres passing within 400 miles of Philadelphia; 3. Mean barometer; 4. Mean relative humidity; 5. 674 separate attacks of acute inflammatory rheumatism.—(Lewis, *Trans. Assoc. Amer. Phys.*, 1892).

TABLE III.—*Showing Month of Onset of Chorea. (409 cases of author, black line; 170 cases of Weir Mitchell, dotted line.)*



Relation of Chorea to Endocarditis.—In a large percentage of patients suffering from chorea examination of the heart reveals the existence of a murmur.

TABLE IV.—*Showing the Relationship of Chorea, Rheumatism, and Endocarditis.*

Author.	Reference.	No. Cases Chorea.	Rheumatism.	Cardiac.
Groendal	*Wien. med. Woch.*, Mar. 26, 1891	52	37	Majority.
Meyer	*Berl. klin. Woch.*, July 14, 1890	121	11	15
Koch	*Arch. klin. Med.*, 1886	267	48	37
Peiper	*Deut. med. Woch.*, July, 1888	30	14	6
Sée	*La Méd. moderne*, Oct., 1891	196	134	
Leroux	*Rev. Mens. des Mal. de l'Enf.*, June, 1890	80	5	5
Dale	*Lancet*, Oct. 31, 1891	20	3	8
Herringham	*Lancet*, Jan. 12, 1889	80	37	20
Garrod	*Lancet*, Jan. 12, 1889	80	36	45
Cheadle	*Lancet*, May 4, 1889	84	62	
Brit. Col. Invest. Com.	*Brit. Med. Jour.*, Feb. 26, 1887	439	116	141
Gowers	*Dis. Nerv. System*, vol. ii. p. 550	100	24	40
Sachs	*Keating's Cyclo. Child. Dis.*, vol. iv. p. 843	70	8	12
Dana	*Arch. of Pediatrics*, Apr., 1888	130	7	8
Sinkler	*Pepper's System of Med.*, vol. iv. p. 442	279	37	82
Starr		448	83	83
		2476	662 26 per cent.	502 +

This murmur is usually a mitral systolic murmur, heard at the apex, only occasionally being aortic or double. In many of the cases the murmur heard appears with the beginning of the attack of chorea, and ceases after the attack is over. Such murmurs are usually considered as blood-murmurs, owing to their association with anæmia, and are not thought to indicate any actual disease of the valves. A certain proportion, however, of patients who have chorea continue to have a cardiac murmur after the chorea has passed away, and just as rheumatism may leave a diseased heart, so chorea may leave a diseased heart; and this is true whether the chorea has been associated with rheumatism or not. It is true that the rheumatic cases of chorea are more liable to develop endocardial murmurs than the non-rheumatic cases, but it is not true that the development of a true endocardial murmur is evidence of the existence of rheumatism in a given case of chorea.

In my own records I have distinguished between cases in which a murmur has been present and has passed away after the chorea has ceased (65 cases), and cases in which the murmur has remained for a period exceeding six months after recovery from the chorea (83 cases). There were 300 cases in which the heart was carefully watched, and in which no murmurs, either functional or organic, appeared. Osler has shown that in a considerable proportion of cases of chorea the complicating endocarditis is independent of rheumatism, but lays the foundation of organic heart disease—an opinion which my experience confirms.

Other Etiological Facts.—It is well known that chorea occurs as a sequel of scarlet fever and measles, whooping-cough and varicella. It is possible that the original infectious agent producing these diseases acts as an irritant to the nervous system. The chorea which occurs during pregnancy need not be considered here as it is not a disease of childhood.

A large majority of the patients suffering from chorea present evidences of anæmia in greater or less degree. It cannot be stated, however, that anæmia is a cause of chorea. It is probable that the same conditions which give rise to anæmia conduce to the development of chorea. The anæmia is frequently so severe as to require treatment simultaneously with the chorea.

While it is possible that local twitchings of the muscles of the eyes or face or neck may be produced by eye-strain or by irritation in the naso-pharynx, true chorea is never, in my opinion, produced by these causes, and treatment directed to the relief of so-called muscular insufficiencies in the eye-muscles is useless.

The exciting causes of chorea are not fully determined, but a certain proportion of the cases develops after sudden mental excitement, such as fright or grief. Thus in 87 cases out of 490 of which I have records, a fright was assigned as the exciting cause, and in the B. C. C. report it is assigned as a cause in 96 cases out of 222. In order to be considered as an actual cause of chorea the mental shock must precede the development of chorea by not more than a week, for it is hardly to be supposed that the effects of any mental shock can appear after a longer interval.

Certain authors have called attention to hereditary influences acting as predisposing causes to chorea, and it is a fact that if the family history be carefully investigated, rheumatism, various nervous disorders, alcoholism, and tuberculosis are frequently discovered.

Pathology.—According to our definition, chorea is a functional disease. This implies that there are no organic changes constantly present as its pathological cause. That all functional diseases are undoubtedly due to disturbance in the nutrition or in the molecular structure of tissues is admitted, and that

in chorea such changes are present in the nerve-cells of motor function is highly probable; but inasmuch as the very large majority of patients suffering from chorea recover entirely, and inasmuch as in many cases of chorea there are no permanent objective symptoms which indicate a loss of any function, it must be admitted that a constant pathological condition visible by the microscope is not to be expected.

Nevertheless, numerous cases of chorea have been examined post-mortem, and many changes have been described in the nerve-cells, in the neuroglia, and in the blood-vessels as characteristic lesions of chorea. The statements made by some authors regarding hyperæmia of the nervous system as a cause of chorea may be dismissed without consideration, for, aside from the question whether hyperæmia or anæmia during life leaves any evidences in the nervous system after death—an open question—these appearances are described in other diseases besides chorea.

Some authorities have described minute hæmorrhages and capillary emboli as the lesions of chorea, but other equally good observers have failed to find these conditions.

Vacuolization of the nervous tissue and of the nerve-cells has been assigned as the lesion of chorea, as have also dilatations of the spaces around the blood-vessels; but this condition has also been described as the lesion of diabetes and of various functional nervous diseases, and cannot be accepted as characteristic of chorea alone.

Hyaline degeneration in the nervous cells of motor function in the cortex and in the basal ganglia has been described, but this is known to be present in epilepsy and in many organic lesions not attended by the twitchings of chorea.

Hyperplasia of the neuroglia has been seen, but this, too, cannot be considered as a necessary accompaniment of chorea, inasmuch as it is permanent, while the disease is temporary.

It is to be remembered that in the majority of cases which have come to autopsy other diseases than chorea have caused the death of the patient, or else the patient has succumbed to a condition of exhaustion which in itself might be sufficient to produce many of the changes described; therefore I do not believe that the pathological anatomy of chorea can be said to be known.

It is not positively determined whether the portion of the motor nervous system affected in chorea is the spinal cord, basal ganglia, or cortex. Probably various cases present various conditions. In the cases in which the mental symptoms are prominent the cortex is undoubtedly involved, and in the unilateral cases the lesion is undoubtedly cerebral. There is little ground for positive statement regarding the situation of the lesion in chorea, and writers too often indulge in theoretical argument.

Diagnosis.—There are many diseases in which the chief and most prominent symptom is a twitching of the muscles. These should not, however, be mistaken for chorea. Tic convulsif, which is a unilateral twitching of the muscles of the face, is usually a reflex spasm due to some irritation in the domain of the trigeminal nerve; which irritation, being conveyed inward to the pons, gives rise to a sudden impulse outward through the facial nerve, just as a bit of dust in the eye gives rise to a wink. The limitation of this spasm to the face, and the fact that in the majority of cases it can be arrested by pressure exerted upon some branch of the trigeminal nerve upon the face, will prevent its being mistaken for chorea.

There is a similar disease, called general convulsive tic or *maladie des tics convulsifs*, first described by Gilles de la Tourette, consisting of a sudden

twitching of any or all of the muscles of the body. This resembles chorea closely, but should not be mistaken for it. It is not attended by any weakness of the muscles or by any awkwardness of voluntary movement; the twitchings do not occur during voluntary movements, but only appear during rest. The disease is a chronic one, appearing as a rule about the fifteenth year and remaining during life. The twitchings are more sudden than those of chorea, and there is no mental irritability. The disease does not appear as early in life as chorea, and it does not yield to arsenic.

Habit-spasm has been mistaken for chorea, but should not be confounded with it. All children have a tendency toward mimicry, and a child who is afflicted by habit-spasm makes movements which have the character of voluntary movements, such as winking, pouting the lips, turning the head, shrugging the shoulders, or moving the extremities: such habit-spasms are not as quick and sudden as the spasms of chorea; after a time they are not easily controlled voluntarily, as they are in the early stage of the affection. Voluntary control can, however, be increased by forcing the child's attention to the necessity of it, and in this condition moral treatment and general hygienic measures, such as baths and proper exercise, are of more service than medicines.

Paramyoclonus multiplex is a spasmodic affection of the muscular system which resembles chorea. In this disease it is the muscles of the body and of the proximal portions of the limbs which are affected; the face and arms and hands and legs do not participate in the spasm. The spasms are bilateral and symmetrical; they occur at intervals, and are rapidly repeated, as many as ninety contractions of the muscles occurring in a minute. The movements during the attack of spasm are very violent, so as to throw the patient down if walking or to hurl him off a chair if seated. The spasm can be brought on by tapping the patellar tendon. During the interval between the spasms fibrillary tremor of the affected muscles may be seen. The disease may occur at any age; it usually develops after some mental or physical strain in patients of an hysterical temperament, and recovery generally takes place after a time. It will be seen from this description that the disease should not be mistaken for chorea.

The hemichorea which follows hemiplegia is characterized by slow, irregular ataxic movements on voluntary motion, and does not consist of twitchings in individual muscles. It should be regarded as hemiathetosis rather than as a species of chorea.

Multiple sclerosis may be the cause of irregular movements, but these never occur when the patient is at rest, and this is not a disease of childhood.

Prognosis.—In view of the facts stated it is evident that the prognosis given to the parents in any case of chorea should be a hopeful but also a guarded one. For while the chances are all in favor of a speedy recovery within three months, they are also in favor of a recurrence of the disease, and in no case is it possible to promise a cure, because of the fact that a few of the cases which cannot at the outset be distinguished from the ordinary cases become chronic and do not recover at all.

Another fact should be mentioned which should lead to a guarded prognosis—namely, that certain children are exceedingly susceptible to the effects of arsenic, which, as we shall see in the section upon Treatment, is the only remedy of value. These children either cannot take arsenic in sufficient doses, or if they take it develop arsenical poisoning or even arsenical multiple neuritis, both of which conditions hamper the treatment exceedingly.

The development of rheumatism during the disease does not necessarily make the prognosis very grave, for few children die of rheumatism. Nor does

the development of endocarditis with organic murmurs in the heart lead to any great anxiety as to the life of the patient: such murmurs may remain through life, and in later years the heart disease may give rise to much trouble; but it is very rare to find in children suffering from chorea and endocarditis any evidence of insufficiency of the heart's action, as demonstrated by œdema of the extremities or œdema of the lungs. Nor have I ever seen hemiplegia develop in the course of chorea as an evidence of cerebral embolism.

Treatment.—The first endeavor of the physician who is called upon to treat a case of chorea should be to direct such an arrangement of the patient's life and surroundings as will remove him from the bad hygienic influences which have conduced to the development of the disease. If the patient remains in a damp or ill-ventilated room, if he be not properly bathed and fed, and if he cannot be kept quiet and without excitement, the prospect of success in treatment is not good. The child should always be removed from school. Nutritious diet of varied character, the digestion of which should be aided, if necessary, by the use of digestants and of laxatives, is important. Long-continued baths are to be recommended, the child being allowed to play in the the water for half an hour twice a day. The bath should be tepid, between 95° and 100° F., and no sudden shock of cold is to be used. The object of the bath is to have a soothing influence as well as to dilate the vessels of the surface, and the sharp contraction of the vessels produced by cold applications is to be avoided. Rest in bed or upon a bed or couch is very essential during the first two weeks of the disease. It is difficult to keep a child who is irritable in bed; therefore it is best for the child to be warmly clad in merino underclothing, but not fully dressed, and to be allowed to play about upon a large bed, but not allowed to run about upon the floor. Gentle massage to the entire body for an hour daily or for half an hour twice a day, the body being anointed with cocoa butter, is of decided benefit. It is better for a child with chorea to see but one or two members of the family, so as to be kept free from all mental excitement. After the child is kept at rest in this manner, being amused in every possible way, being fed frequently, bathed and massaged, a very marked improvement will be noticeable within two weeks.

The improvement can be hastened materially by the use of medicines. The treatment of a case of chorea will depend somewhat upon the mode of its onset. If the child has had an attack of acute articular rheumatism just preceding the chorea or associated with it, and if he has pains in the limbs and a rise of temperature in the evening, it is much more important to treat him with salicylate of sodium or salicin or salophen than with arsenic. These remedies may be used in connection with antipyrine, phenacetin, or exalgin, the latter drug being of considerable service in the early stage of an acute attack. In the use of these remedies the condition of the heart must always be taken into account, and heart stimulants added if necessary. I prefer camphor and caffeine to other heart stimulants in this condition. The dosage of these remedies must depend entirely upon the severity of the symptoms and upon the age of the child. It may be necessary to give to a child of eight years ten grains of the salicylate of sodium every two hours for several days; it may not be necessary to give more than ten grains three times a day. Exalgin is to be given in three-grain doses every four hours in a severe case, and three times a day in a mild case. With children I prefer to use these remedies in capsules, as the disagreeable taste is then avoided.

If there be no history of rheumatism, it is well to think of the possibility of malarial infection as a cause of chorea. If there be a daily periodical rise of temperature, with or without a chill, or if an examination of the blood

reveals the presence of the malarial plasmodium, a dose of calomel, followed by Warburg's extract in capsules, or quinine in capsules, kept up for a week, will be efficacious in cutting short an attack of chorea.

Arsenic is the chief remedy for chorea not complicated by rheumatism or by malaria. Fowler's solution is the best preparation to use, being tasteless. It is to be begun in three-drop doses three times a day, the number of drops being increased daily one drop until physiological effects are produced. These are a puffiness of the eyelids noticeable on waking in the morning, and slight nausea or griping pains with diarrhœa. It is possible in some children to reach a dose of fifteen drops of Fowler's solution three times a day without the production of these effects; many children take ten drops three times a day without discomfort. It is my rule to keep on increasing the dose until the physiological effects appear. When this occurs the medicine is to be stopped for twenty-four hours, and then resumed at the dose just below that which produced poisoning; and this dose is to be kept up regularly so long as treatment is needed. Arsenic should always be given after eating and well diluted with water. There are some children who cannot take it in efficient doses without producing poisonous effects. In these reliance must be placed upon the hygienic rules already laid down, and if the chorea is very severe chloral may be given, the condition of the heart being carefully regarded during its administration. In some cases which do not yield readily to arsenic it is well to employ chloral in combination with it, giving from five to ten grains three times a day. In some cases tincture of cimicifuga is of service.

A few cases of chorea present very severe symptoms, the spasms being so extensive and violent as to throw the patient about in bed and even to prevent sleep. In these the use of a combination of bromide of potassium and chloral (bromide 30 grains, chloral 15 grains), given two, three, or even four times a day by the rectum, is advisable, while at the same time arsenic is used by the mouth, being given in eight-drop dose in milk. A few patients are kept awake by the movements and rapidly become exhausted: in these cautious administration of chloroform by inhalation may be necessary in order to secure the needed sleep. The hypodermatic use of hydrobromate of hyoscine in dose of $\frac{1}{200}$ grain for a child of eight years, once in twelve hours, may be tried in very violent cases. Sulphonal and chloralamide are valuable hypnotics in such cases.

In addition to the foregoing treatment of the disease, it is usually necessary to remove the condition of anæmia which is present in the majority of cases, and therefore iron must be given in any form which may be preferred. The solution of the albuminate of iron is perhaps the best form to use for children, although the chocolate lozenges containing iron may also be given freely. Every form of nutritious food, especially milk and cream, and cod-liver oil, if the child can be made to take it, is also indicated.

When medicinal treatment appears to be of little service, a change of air, especially a change to the sea-shore, is often of very great benefit. The sea air is much more conducive to recovery than mountain air, though sea-bathing is not to be recommended. In any case a certain amount of open-air life should be enforced during the treatment.

TETANY.

By HENRY M. LYMAN, A. M., M. D.,

Chicago.

Tetany is a functional disease of the nervo-muscular apparatus, characterized by the occurrence of paroxysmal tonic spasms that involve certain groups of muscles, and that in severe cases may extend to nearly all of the voluntary muscles of the limbs and body. The nerves that are concerned in the production of these contractions exhibit a considerable increase of electrical and mechanical excitability.

The functional character of the disease has led many observers to doubt the propriety of dividing it from other functional spasmodic disorders. The infrequency with which it is encountered in certain localities and among certain races has also created a degree of scepticism regarding the disorder as a separate entity. But this lack of unanimity is principally due to the fact that tetany prevails chiefly among women and children who belong to neurotic families and are subject to unfavorable conditions of living. It will be observed more frequently by physicians in general practice than by those whose experience is limited to office and consultation practice.

Etiology.—Tetany occurs most frequently among children during the period of first dentition; it is especially connected with gastro-intestinal disorders which interfere with nutrition, and is associated with an exaggerated excitability of the nervous system at the period of life when those tissues are naturally more unstable than during later years. For somewhat similar reasons it is not infrequent among young people near the age of puberty. The influence of sex is not very decided; it is less conspicuous than are the influences that are derived from ancestral sources. The children of nervous, weakly parents are particularly liable to the disease. Constitutional causes and diathetic influences which favor the development of scrofula, arthritism, and rickets are powerful predisposing causes of tetany. The disease is, in fact, closely allied to those spasmodic tendencies that are so commonly witnessed among rachitic children. It is undoubtedly due to insufficient diet and to the other predisposing causes of rickets that the disease is so often encountered among children in orphan asylums, foundlings' homes, and similar congregations of ill-conditioned infants.

Among the exciting causes of tetany, exposure to cold exhibits great prominence. The disease is more often experienced during cold weather than in summer. Exposure to cold and wet has been noticed as an antecedent of the disease, and its manifestation is sometimes accompanied by articular swellings that are highly suggestive of rheumatism.

When a predisposition to tetany exists, almost any irritation of the cutaneous or mucous surfaces of the body may excite an attack of the disease. It is therefore frequently observed during the course of infantile diarrhœa

and other irritative disorders of the alimentary canal. Among female patients its occurrence is closely connected with menstrual disorders, pregnancy, and lactation. It has been observed as a sequel of various infective diseases, but it is probable that in such cases the infection merely lowers the resistance of the nervous system, so that morbid manifestations of various character are more easily excited. When a predisposition has been established, almost any active disturbance of a peripheral character, or even of a psychical origin, may suffice to arouse a paroxysm.

Symptoms.—The occurrence of an attack of tetany is usually preceded by certain premonitory symptoms of nervous disturbance. Occasionally the patient complains of dizziness, determination of blood to the head, humming sounds in the ears, and flashes of light before the eyes. Various perversions of sensation in the limbs may be also experienced. When, finally, the attack is matured, it is upon the fingers and toes that the force of the paroxysm is usually expended. The muscular spasms are generally bilateral, and in ordinary cases they are limited to the flexor muscles of the fingers, wrists, and toes; the extensor muscles escape more frequently than the flexors; sometimes the muscular groups of the forearm, upper arm, leg, and thigh are involved. In certain rare instances the muscles of the abdomen, thorax, neck, face, eyes, tongue, pharynx, diaphragm, and bladder may participate in the tonic spasm. The tips of the fingers and thumbs are frequently drawn together into the conical position assumed by the accoucheur when about to introduce the whole hand into the vagina. The great toe is flexed and bent laterally under the other toes, which are also drawn down into the position of plantar flexion. Occasionally the toes and fingers are spread apart, instead of being tightly drawn together. The upper arm is drawn against the side of the thorax, while the forearm is partially flexed and crossed over the front of the body. The legs are usually extended, but the thighs are adducted, and are sometimes flexed upon the body. When the muscles of the trunk and of the neck are invaded respiration becomes difficult, and suffocation sometimes appears imminent. When the paroxysms succeed one another intermittently, the phenomena of tetanus are closely counterfeited, though, fortunately, the comparative brevity of the attack and the rarity of a fatal termination mark a decided difference between the two diseases.

During the course of the paroxysm the peripheral nerves of sensation exhibit various disorders. Sensations of cold, heat, numbness, and formication are not uncommon. Neuralgic pains and a feeling of soreness in the contracted muscles are often experienced, together with headache, dizziness, and other cerebral symptoms of sensory disorder.

Three cardinal symptoms deserve notice: Trousseau many years ago remarked that pressure exerted upon the large arteries and nerves of the limbs of a patient would be often followed by the development of a paroxysm of tetany. In this way a latent predisposition may be aroused to active manifestation of the disease. This phenomenon is more easily produced in the upper extremity than in the lower. Occasionally the paroxysm may be excited by pressure upon the carotid artery and the sympathetic ganglia in the neck.

A second characteristic depends upon the increase of electrical excitability in the motor nerves of the body and limbs. When applied to the nerves, very weak faradic currents are sufficient to excite muscular contractions. The application of galvanic currents also indicates great increase of excitability, so that tetaniform contractions of the muscles can be aroused by currents which ordinarily would scarcely be noticed. This inordinate sensitiveness to

electrical excitation is frequently manifested in latent cases where the fully-developed paroxysm has never been experienced.

The increased excitability of the motor nerves is further indicated by their behavior under the influence of mechanical stimulation. A slight tap upon the trunk of a nerve is often sufficient to arouse a paroxysm, even though the muscles themselves cannot be thus thrown into contraction by direct percussion. When the facial nerves are involved the muscles of the face may be easily brought into a state of spasmodic contraction by tapping upon the trunk of the nerve at its point of emergence from the bony canal, or by drawing the point of the fingers across the face from the external angle of the orbit to the styloid foramen.

Besides the various disturbances of sensation that have been already noted, painful pressure-points are sometimes discovered over the spinous processes of the vertebræ.

The duration of a paroxysm may vary from a few minutes to many hours, or even two or three days. In cases of such long duration muscular spasm persists even during sleep, though its intensity is considerably diminished. The number of paroxysms during the course of an attack is also subject to great variation. A single paroxysm sometimes terminates the attack, while in other cases the spasms follow one another at brief intervals, almost like the paroxysms of genuine tetanus.

Pathological Anatomy.—Since tetany rarely proves fatal, the opportunity for investigation of its pathological anatomy is seldom offered. It is probably a functional disease of the whole nervous system, but many of the morbid processes that have been described are the results of predisposing diseases, or of the convulsive paroxysms to which the patient has been subjected, rather than causes of its phenomena. Among these, undoubtedly, are the slight hæmorrhages that have been noted in the membranes of the cord and in the cord itself. The various conditions of hyperæmia and actual inflammation that have been sometimes remarked are also of the same accidental or complicating character. The reflex nature of the symptoms and their production by irritation of the peripheral nerves render it probable that the disease has its principal seat in the spinal cord, though the reflex arcs in which the cranial nerves are included sometimes display evidence of disturbance in a way that indicates an extension of disorder throughout the entire length of the nervous axis. The occurrence of the disease after diarrhœa and other wasting discharges suggests the idea that this inordinate excitability of the nervous centres is in some way connected with malnutrition and with the exaggerated irritability that is thus induced. It is not impossible that these conditions are dependent upon an infection that has invaded the tissues of the spinal cord. The occurrence of the disease after extirpation of the thyroid gland has aroused a suspicion that tetany, like myxœdema, may be due to an auto-intoxication with mucin. But these speculations have not yet emerged from the realm of hypothesis.

Diagnosis.—Tetany may be easily recognized by the occurrence of paroxysmal tonic contraction in particular groups of muscles, usually the flexors of the extremities, and by the increased reaction that takes place after electrical or mechanical excitation of the peripheral nerves. By attention to these phenomena the disease may be readily distinguished from tetanus, a disorder which, moreover, usually commences with trismus—a symptom that is rarely observed in tetany. Similar facts of dissimilarity serve to distinguish tetany from the convulsive paroxysms of hysteria, and from the spasmodic movements that are sometimes witnessed in writer's cramp and the allied pro-

fessional neuroses. The spasmodic attacks that sometimes occur as a consequence of ergotism very closely resemble tetany, and should probably be considered as belonging to the same class of toxic disturbances of the nervous system.

Prognosis.—The disease is seldom fatal, but sometimes it persists for a considerable period of time. In such lingering cases a certain degree of muscular contracture and weakness is occasionally evident on careful examination, even after the cessation of spasmodic attacks. Mechanical or electrical excitation of the nerves may then suffice to arouse a more or less complete paroxysm.

Treatment.—In the management of tetany special reference must be made to the underlying causes of the disease in each individual case. Disorders of the alimentary canal require appropriate treatment; all exhausting discharges, such as hæmorrhage, diarrhœa, excessive menstruation or the opposite condition, prolonged lactation, inordinate perspiration, etc., demand attention. Rheumatic and tuberculous patients require the treatment that is appropriate to such diathetic conditions.

Electricity has been employed with but indifferent success. Counter-irritants of all kinds have been applied to the spine, and hydropathic treatment has also been prescribed with varying degrees of benefit. For the relief of the paroxysm the various narcotics are generally recommended. Bromide of sodium, cannabis Indica, hyoscyamus, belladonna, chloral, ether, chloroform, valerian, oxide of zinc, and the opiates have been exhibited with temporary advantage. In severe attacks it is advisable to administer ether by inhalation and to employ non-volatile remedies by hypodermatic injection. Calabar bean and curare are too powerful and uncertain for administration in this disease. The principal object of treatment should be the improvement of the general health of the patient and the removal of all unfavorable conditions that interfere with nutrition. For this reason hygienic measures and dietetic management are more important than specific medication for the palliation of symptoms.

PSEUDO-HYPERTROPHIC MUSCULAR PARALYSIS.

By FRANCIS T. MILES, M. D.,

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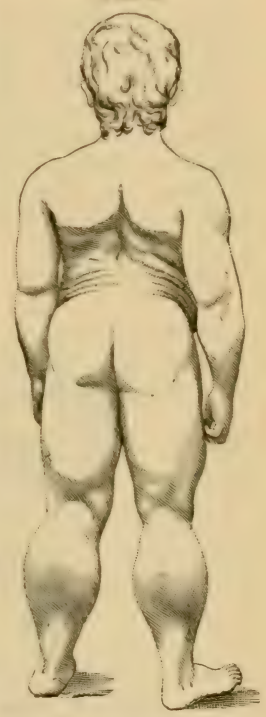
The essential feature of this disease is a progressive loss of power in certain definite muscles and groups of muscles, and its most characteristic and distinguishing symptom (from which it has received its name) is the increase of volume and apparent hypertrophy in some of the weakened muscles.

Symptoms.—It is a disease of early childhood, the great majority of cases occurring before the tenth year. It is but seldom that its invasion appears to begin about or after the time of puberty, and it is probable that the eye of one accustomed to the disease would have discovered indications of it long before that time. As a rule, the first symptom that arrests the attention of the parents or nurse is the seeming clumsiness manifested by the child in using his legs. A slight trip or jostle causes him to fall, and then he gets up slowly. He walks with a straddling, inelastic gait, ascends steps laboriously, clinging to the banisters and pulling himself up. Sooner or later (in some cases it is the first thing to attract attention) certain muscles begin to develop out of proportion to the rest, and are hard and elastic to the touch. Usually the first muscles to show this increase of volume are those of the calves of the legs, with which are generally associated the glutei, one or more of the divisions of the quadriceps extensor, and the erector spinæ in the lumbar region. But the hypertrophy affects other muscles than those of the lower limbs. Thus the infraspinatus is very commonly much enlarged, frequently the deltoid, and even the biceps and triceps are sometimes involved. The escape of the muscles of the hand and forearm, which have been but very rarely described as implicated in this affection, gives a distinctive peculiarity to this form of muscular paralysis. The neck and face do not show an absolute immunity, and cases of hypertrophy of the sterno-mastoids, temporals, masseters, and even of the tongue, have been recorded. In a case of Bergeron's all the muscles except the pectorals and sterno-mastoids were increased in volume, thus giving to the child an appearance of great athletic development.

In marked contrast to the Herculean proportions of the muscles is their strength, which is almost always so greatly diminished that they are incapable of performing their required functions. After a time these muscles cease to increase in size, and then begins a diminution of their volume, which may go on to complete atrophy, with corresponding absolute loss of power. But by the side of these enlarged and feeble muscles we observe others whose power is diminished more or less while they retain their normal size, or are from the first involved in a process of atrophy. In the lower extremity this loss of power is manifested in the flexors of the hip, which, though out of reach of direct observation, are thus evidently invaded by the disease. The extensors

of the hip and knee may be under-sized or atrophied, and always much weakened. The flexors of the knee are but rarely affected. Of the muscles of the upper extremity, those of the shoulder-girdle are generally more or less atrophic, especially (indeed, almost without exception) the costal portion of the great pectoral and the latissimus dorsi. Less frequently, but not uncommonly, the biceps and triceps are small and weak. If we attempt to lift the child by placing the hands under its arms, we find that the shoulders yield against the weight of the body, and are dragged almost to the back of the head.

FIG. 1.



Pseudo-hypertrophic Muscular Paralysis.

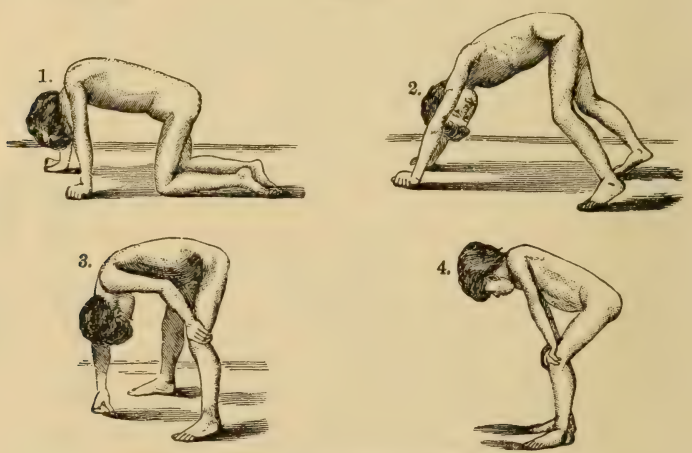
This mixed and variable picture of hypervoluminous and atrophied muscles would seem to indicate that the pseudo-hypertrophy is, as it were, an accidental factor, and that the intrinsic nature of this disease is the progressive loss of power in certain muscular groups. Indeed, cases have occurred in which all the motor symptoms of pseudo-muscular hypertrophy were present, but in which the diseased muscles that caused these symptoms presented no alteration of volume. In the words of Charcot: "The hypertrophy is not, all things considered, an essential element in the constitution of the affection called pseudo-hypertrophic paralysis." We will return to this point farther on.

On account of the weakness of the muscles involved, the attitude in standing and the manner of walking in this disease are peculiar and characteristic. In a state of health, while standing erect the centre of gravity of the body falls slightly in front of the point of support, and the hip- and knee-joints are not in a position of complete extension; so that to maintain the equilibrium and to prevent the flexion of those joints a sustained action of the erector spinæ and the extensors of the hip and of the knee is demanded. In the disease under consideration an involuntary effort is made to relieve these enfeebled muscles by throwing the centre of gravity very far back. To do this the lumbar concavity is increased as much as possible, so as to throw the weight of the head and shoulders behind the hip-joint, thus producing a marked lordosis, with a corresponding protrusion of the chest and belly. The knee-joints are fully extended (locked), so that the weak quadriceps extensors are at rest, while the base of support is broadened by the wide separation of the feet. The lordosis disappears when the child is seated; but in an advanced stage of the disease, when the erectors of the spine are greatly weakened, a kyphosis may for the time take its place. When standing the patient may be able to raise himself on his toes, but cannot spring from the floor. In ordinary natural walking, while one foot is off the ground and is being propelled forward the centre of gravity of the body falls much nearer the median line than the supporting foot, and, indeed, it continues to move toward the opposite side until the advancing foot reaches the ground and receives the weight of the body. During this time the weight of the body is sustained upon the head of the fixed femur, principally by the glutei muscles. In pseudo-hypertrophic paralysis, these muscles being too weak to perform their task, the patient relieves them by throwing the body far over to the side of the sustain-

ing foot, thus bringing the weight over the point of support, while the other leg swings forward. This manœuvre, being repeated alternately for the two limbs, gives a peculiar and characteristic swaying motion of the body from side to side in walking. This false position of the trunk and the weakness of the extensors of the knee hinder the foot being projected forward to the length of a full step, and, instead of the heel touching the ground first, as is usual in walking, the ball of the foot or the toes first descend, giving the appearance of an attempt to step softly. This stepping on the toes is sometimes caused by a contraction of the muscles of the calf, which may occur early in the disease.

Very characteristic and almost pathognomonic of this disease are the manœuvres executed by the child in getting into the erect from the recumbent position. They were first and with great clearness described and explained by Gowers. The weak extensors of the hip and knee are not equal to the work of extending these joints and giving the erect position to the body against the

FIG. 2.



Postures in rising to the Erect position (Gowers).

weight of the head and shoulders. The child, therefore, unable to assume the sitting position, takes that of "all fours," thus throwing the weight upon the hands and arms, while the legs are being straightened. He then works his hands backward along the floor until he gets to a position from which with an effort he can grasp the legs above the knee, and then, by alternately clasping them at a higher level, he thrusts the trunk into a more and more erect position, until by a final push he jerks the spine into the position of lordosis already described. To use the common and appropriate phrase, he "climbs up his legs."

We have already said that the hypertrophied muscles after a time lose their volume and become atrophied. This may not take place until after many (ten to fourteen) years, and does not affect all of the hypertrophied muscles at the same time. Those of the upper extremity are generally the first to undergo the change, the muscles of the calf being the last to lose their volume. Increasing weakness more and more circumscribes the movements of the patient, until at last he can no longer walk or stand, although the movements of the arms and hands may still, in a measure, be retained. Now contractions of the wasted muscles set in, and joints, as the knee and elbow, are fixed in the position in which they are usually maintained. The ankle-joint takes the position

of pronounced talipes equinus, partly from fixation in the position in which unsupported it hangs, and partly from contraction of the muscles of the calf. From loss of power in the spinal muscles there may result lateral curvature.

The tendon reflexes, as a rule, show no change, except that they grow more feeble as the muscles become weaker, until they are finally lost.[1] The sphincters are unaffected.

Fibrillary contractions have been observed so rarely as to make it presumable that they are caused by some intercurrent trouble, such as neuritis. While the electric reactions are gradually diminished and lost, they are qualitatively normal, and in the very few cases in which degenerative reaction has been described it is probably due to some secondary cause similar to that which causes the fibrillary contractions in certain reported cases. Sensation is normal, and mental impairment, although occurring in some instances, does not seem to be a consequence of the disease. A symptom which might be referred to an affection of the vaso-motor nerves is the bluish mottling or marbling of the skin of the lower limbs which is sometimes seen. There is no evidence of any disturbance of the sympathetic nerves.

The disease runs a chronic course, it may be of ten or twenty years' duration, and does not itself directly cause the death of the patient. This termination is usually the result of some intercurrent respiratory trouble, to which the enfeebled condition of the patient gives force.

Etiology.—Hereditary influence can be traced in a large majority of cases, and exclusively through the mother, who, without being herself a subject of the disease, may nevertheless transmit this developmental defect to her offspring. Males are much more frequently affected than females, and in the latter it tends to develop later in life and progress more slowly. The disease may be considered as a congenital affection, for even when it develops after the period of childhood, as it sometimes, though rarely, does, there is reason to assume that the defect of muscular development has merely lain dormant during the earlier years of life. No other etiological factors, as syphilis or alcoholism, have been recognized in the causation of the disease. For a long time after pseudo-muscular hypertrophy had been observed and fully described clinically, it was considered a disease of spinal origin, a myelopathy. But more recently the opinion that it is a primary disease of the muscles, an idiopathic myopathy, has received a very general sanction from pathologists. It is recognized as one (and the most frequent) form or type of a group of myopathic atrophies, or muscular dystrophies, of which Erb's juvenile type, the facio-scapulo-humeral or infantile type, and it may be Leyden's hereditary type, are the most distinctively marked forms: "The infantile type is characterized by the early facial paralysis, the juvenile type by the time of its development (early youth) and localization of the atrophy (in the muscles of the shoulder-girdle); the pseudo-hypertrophic type by its development in early childhood and the predominance of the lipomatous condition of the muscles; the hereditary type (Leyden's) by its heredity."

While these forms of muscular atrophy are fairly separable clinically when well marked, there are numerous transition forms which cannot be easily classified. Not infrequently the different types occur in members of the same family, and arise presumably from the same inherited defect.

As Erb has shown, there are no greater differences amongst these varie-

[1] The writer has recently seen a case of pseudo-muscular hypertrophy in a boy nine years old, in which the knee-jerk was abolished, although he could still walk, and the partly hypertrophied quadriceps extensor could extend the knee almost completely when the patient was seated.

ties than there are amongst the individual cases of any one variety. Thus in the pseudo-hypertrophic form we have fairly constant atrophy of the muscles of the shoulder-girdle and arm—*i. e.* those characteristically affected in the juvenile type; and in some cases described by Erb there was atrophy of the muscles of the face, the mark of the infantile type. Indeed, Erb suggests that many cases having the clinical aspect of the pseudo-hypertrophic form, afterward, as the adipose matter is absorbed, take on the appearance of the juvenile type of muscular atrophy.

Pathological Anatomy.—The essential feature of the pathological anatomy in this disease is a degenerative change in the muscular tissue itself; and this change is probably the first which takes place. Pieces cut from the living muscles (which are much to be preferred to morsels extracted by the "harpoon"), and properly prepared, present the following microscopic appearances: The muscular fibres in cross-section are seen to have lost their polygonal outline, to have become rounded in contour, even to be complete circles. Amongst fibres of normal size there are those which are hypertrophied, and others which show atrophy in varying degree, even to the point of complete disappearance. The abnormal increase in volume of the muscular fibres would, from recent observations (Erb), appear to be an essential feature in the muscular atrophies, and it may be that it is a condition of the fibres which very generally precedes their atrophy. At any rate, such hypertrophied fibres are rarely, if ever, wanting in preparations of muscular tissue taken from these diseases. This increased volume of the fibres cannot be explained by their contraction after excision, since it is seen when precautions are taken to counteract this. In addition, the fibres show a splitting in the longitudinal direction and the formation of vacuoles in their interior. The muscle-nuclei are sometimes more, sometimes less, but always considerably, increased.

The alteration of the connective tissue must follow very closely, if it is not coincident with, that of the muscular fibres. A proliferation with increase of its nuclei goes on *pari passu* with the muscular atrophy, until finally it becomes excessively developed. In pseudo-hypertrophic muscles the connective tissue is not only increased, but is crowded with fat-cells. It is this condition, indeed, to which they owe their increased volume and hardness. In muscles primarily atrophied, and in the pseudo-hypertrophic muscles after they have undergone atrophy, there is little or no adipose matter, only a greater or less amount of connective tissue (connective-tissue cirrhosis of Erb). In muscle preparations from the dead body the microscopic appearances are practically the same as those seen in pieces from living muscles. It is of great importance to observe that the microscopic appearances in muscles taken from the different types of muscular dystrophy do not differ more from each other than do those in preparations obtained from different cases of the same type, nor, indeed, than those in different specimens from the same individual. Not only do the pathological changes in the muscles bear a very close resemblance in all the types of muscular dystrophy, but these changes as closely resemble those found in other forms of muscular atrophy, as, for instance, the spinal atrophies and those attending arthritic disease. "The proof for or against the pure myopathic nature of the progressive muscular atrophies cannot at present be furnished by histological research."

Investigations of the nervous system, both central and peripheral, have in such a large majority of cases given a negative result that the reports of lesions of the spinal cord, though made by competent observers in recent cases, will scarcely change the generally accepted opinion that the muscular dystrophies do not depend on discoverable nerve lesions. The question, however, has

arisen, and still awaits its answer, as to whether the muscular dystrophies are absolutely myopathic, or whether functional disturbances ("dynamische Störung") in the trophic mechanism of the cord, too subtle to be ascertained by our present methods of investigation, may not set up at first hand nutritive changes in the muscles. Some considerations certainly point in the direction of classing these diseased conditions of the muscles with the trophoneuroses.

Diagnosis.—When the disease has advanced to a point where the athletic proportions of the hypertrophied muscles stand in strong contrast to their weakness, and where, moreover, along with these over-developed muscles, we have others which are atrophied, there can be little difficulty in making the diagnosis. Gowers claims diagnostic importance for the "condition, which is seldom absent," "of enlargement of the infraspinatus, with a wasting of the latissimus and lower part of the pectoralis." In cases where the enlargement of the muscles is slight, or, as in some instances, where they retain their normal size, the difficulty may be greater. The peculiar position in standing, and, still more, the makeshift movements of the patient in rising from the recumbent position, are almost positive evidence of the disease, whose main characteristics depend on the invasion and weakening of the muscles employed in these acts.

From a progressive chronic neuritis, which might cripple these muscles, the diagnosis would most likely be made by the absence of fibrillary contractions and of degenerative reactions, both of which symptoms belong to neuritis. A history of other members of the family having suffered with atrophy of the muscles would be strong confirmation. Congenital spastic paraplegia, in which the muscles sometimes exhibit a considerable volume, is distinguished from pseudo-muscular hypertrophy by the muscular spasms and the increased myotonus, which shows itself in an exaggerated knee-jerk, and often in ankle-clonus. The different types of muscular dystrophies may be distinguished among themselves by marks already given.

Prognosis.—In this disease no hope can be entertained of recovery, and very little of delay in its progress, which in children is infallibly to utter helplessness, with all the intercurrent risks incidental to that state. The best cared-for will generally live longest, but the great majority never attain adult years. In girls the outlook is somewhat more favorable as to length of life. Cases where the disease has not developed till later years have been seen to progress more slowly, and even to come to a standstill before the power of standing and walking was lost.

Treatment.—It is in vain that we look for any drug which will exert direct influence on the diseased processes in the muscles. Tonics, arsenic, cod-liver oil, etc., can only benefit indirectly by improving the general nutrition. In children, as soon as the disease is suspected, or, indeed, in all the children of a family in which any one of the muscular dystrophies has shown itself, a scrupulous and untiring enforcement of all the rules of health with regard to diet, fresh air, and exercise should be observed. Gowers argues with convincing force on the probable benefit of judicious exercise of the affected muscles. The cold mottled limbs would indicate the employment of massage. Electricity, so far, seems to have exerted no beneficial influence. For the contractures so marked in the last stage of the disease, tenotomy is unhesitatingly to be employed. This is especially demanded in the contractures of the calf-muscles, which sometimes occur early in the disease and render walking or standing impossible.

FACIAL PARALYSIS AND PROGRESSIVE FACIAL HEMIATROPHY.

By CHARLES W. BURR, M. D.,

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I. Facial Paralysis.

Facial Paralysis, Bell's palsy, or mimetic paralysis, is due to injury or disease of the motor portion of the seventh cranial nerve or its nucleus.

Etiology.—Cases occurring at birth are due frequently to pressure of the forceps upon the nerve at its point of exit from the skull; or even if forceps are not used and the labor is normal, though much prolonged, paralysis may ensue. In the latter case it is due to pressure exerted either by the promontory of the sacrum or by the ischiatic spines. A few cases have been reported which were caused by the pressure of intrapelvic tumors.

The causes acting after birth are the same as those which occur in adult life, but the affection is not nearly so common in infants as in older people. The most common cause is cold, which acts by setting up a neuritis—the so-called rheumatic palsy. Ear disease, especially if caries of the bone and suppuration be present, is a common causative factor. It is undoubtedly true, however, that the affection may develop when only the lining membrane of the tympanum is inflamed, without accompanying bone disease. Tumors, meningitis, or fracture of the base of the skull are occasional causes. Surgical operations in the region of the ramus of the jaw are quite frequently followed by palsy due to division of the nerve. A blow in the same region may have a like effect. Certain acute infectious diseases—as, for example, diphtheria—may be causative. Very rarely it occurs in acute infantile spinal palsy. Non-traumatic cases, in which the onset is sudden and the palsy complete, and in which there is no evidence of cerebral disease, must be due to hæmorrhage in the nerve-sheath or Fallopian canal. Gowers has seen two cases, and Wilks and Moxon have found the hæmorrhage after death.

Symptoms.—Often there is preceding pain in the ear or over the entire side of the head, and a slight swelling may be present in the region of the parotid gland. The onset is rapid—rarely, as stated above, sudden. The child may be put to bed well and wake up affected. Usually in from a few hours to a few days the palsy reaches its height. There is ordinarily little or no constitutional disturbance.

In very young children the signs of palsy may be very slight, on account of the greater quantity of adipose tissue, the greater elasticity of the skin, and the smaller muscular development. There may be when at rest only a slight drooping of the angle of the mouth. When, however, the infant cries or laughs, the deformity becomes marked. The affected side remains motionless, the eye cannot be closed, the cheek and ala of the nose fall in and out with inspiration and expiration, and the mouth is drawn strongly toward the sound

side. Most often the tongue and soft palate are unaffected, and the child experiences no difficulty in nursing. Taste may be lost in the anterior half of the tongue on the affected side. The reaction to electricity depends upon the severity of the attack and the time which has elapsed since the onset. In a typical case reaction of degeneration appears after a time. After some months in severe cases, but not in those in which the palsy remains complete, contractures develop on the affected side, making it on first view appear to be the sound side. Examination during movement, however, reveals that the diseased side moves much less. The contracture causes, furthermore, a wrinkle which has no analogue on the sound side. It must be remembered that in some cases only a part of the nerve may be palsied—only the mouth or only the orbicularis palpebrarum—and also that both nerves may be affected.

Diagnosis.—The palsy is unmistakable, and the only question is whether the lesion is central or peripheral. If the lesion be situated above the nucleus, there is never lasting, but sometimes transient, palsy of the eyelid. Emotional movement is less impaired by central disease than voluntary movement. Reaction of degeneration is never present in central disease, and is never absent in peripheral disease unless the palsy be very slight. In the former the reflexes are present, in the latter they are lost. If taste be lost, the lesion is within the Fallopian canal. In disease of the nucleus the orbicularis oris is not affected.

Prognosis is excellent in the cases due to pressure at birth and in those from diphtheria. Gowers justly lays great stress on the prognostic value of the electric excitability of the nerve. If, he says, it is not below normal at the end of ten days, recovery will probably follow in a few weeks. If at the end of a fortnight it is absolutely lost, the palsy will certainly last several months.

Treatment.—The first indication is, of course, to remove the cause if possible. In recent cases, due to cold, hot fomentations should be placed in front of and below the ear. Blisters should be applied over the mastoid process or occiput. Hot baths and free purgation are very useful.

Galvanism is useful when the condition has become chronic. The positive electrode should be placed below the zygoma, and the negative moved gently over the muscles. The least amount of current sufficient to produce muscular response should be used. But little can be done to influence contracture. Daily gentle massage of the face is at least harmless.

II. Progressive Facial Hemiatrophy.

Progressive Facial Hemiatrophy—also called Neurotic facial atrophy, Facial trophoneurosis, Prosopodysmorphia—is a chronic progressive disease characterized by wasting of the skin, fat, connective tissue, bone, and sometimes, but to a less degree, the muscles of one or very rarely both sides of the face.

Etiology.—The disease, while absolutely rare, is far more frequent in females than in males. Of 92 cases collected by Hermann Steinert, 60 occurred in the former, 30 in the latter, and in 2 the sex was not mentioned. It is most apt to occur in early life. In 29 cases the onset was before the tenth year, 24 began between the tenth and twentieth years, while only 22 occurred between the twentieth and fiftieth years; in 1 the onset was at sixty years. Traumatism seems to exert a positive causal influence, as in quite a number of cases injuries to the face, the jaw, or the head preceded but a little while the first symptoms. It sometimes follows an acute infectious disease.

Symptoms.—The major symptom, wasting, may begin either diffusely or

in one spot, spreading thence slowly, and involving skin, subcutaneous tissue, the muscles mayhap, and the bone. The atrophy is most marked in the bone if the disease begins during the period of active growth. Usually the process stops abruptly at the middle line, making the face look as if it were made up of halves from different people, but it may involve both sides, and even extend, it is alleged, to the shoulder and arm. The skin on the wasted side is thinner and paler. The hair may become simply gray, finer, and smoother, or it may fall out. The alveolar processes waste and the teeth are shed. The lower jaw becomes both thinner and shorter. The orbital fat disappears and enophthalmus develops, but the eyeball is not affected. There is sometimes an associated hemiatrophy of the tongue. Pain and numbness are not uncommon, but anæsthesia is rarely present. Anidrosis, weakness of the carotid pulse, and loss of the power to blush are occasional symptoms. There is never marked difference of the surface temperature of the two sides of the face. The special senses are never affected. There are no changes in the electrical reactions of nerves or muscles. The diseased side in well-advanced cases may produce an expression mimicking the drawn features of old age.

The disease follows a slowly progressive course, sometimes extending over many years, or it may, after reaching a certain stage, cease to progress.

Pathology.—The pathology of the condition remains as yet almost entirely theoretical. Mendel has made one autopsy in which he found an interstitial neuritis of the trifacial from its origin to the periphery. In an atypical case of Horner a tumor was found pressing on the Gasserian ganglion and the trifacial nerve. Taking all things into consideration, it is probable that the future will show that disease of this nerve stands in close causative relation to the affection.

Diagnosis in a well-developed case is easy. The only conditions with which it can be confounded are congenital facial asymmetry due to torticollis, facial paralysis, and facial hemihypertrophy. These need only be named to avoid error.

Treatment has so far been absolutely valueless. On theoretic grounds Dercum in 1891 recommended section of the various branches of the trifacial. He holds that the condition depends not upon failure of trophic nerve stimulus, but upon a radical perversion of that stimulus.

INFLAMMATORY DISEASES OF THE SPINAL MENINGES AND SPINAL CORD.

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I. SPINAL MENINGITIS.

Spinal Meningitis is an inflammation of the covering membranes of the spinal cord.

The varieties of meningitis ordinarily described have been somewhat arbitrarily based upon anatomical considerations. As the dura or the softer membranes are principally involved, the terms pachymeningitis and leptomeningitis are respectively employed, but a sharp division is impossible clinically, and is not found post-mortem.

For purposes of description we may consider — 1st, Pachymeningitis, or external and internal inflammation of the dura; and 2d, Leptomeningitis, or inflammation of the pia. But inflammation of the inner surface of the dura must from contiguity involve the leptomeninges more or less, so that the conditions are usually associated, and meningitis originally external may finally invade the pia. Association with myelitis is hardly less frequent; mixed forms, therefore, or meningo-myelitis, are common, and are to be classed as the thecal or cord symptoms may predominate.

Pachymeningitis Externa.

Pachymeningitis externa, or external dural meningitis, is due to chronic irritation and inflammatory conditions invading the spinal canal, and is therefore secondary to other morbid states. Thus, vertebral tuberculosis, Pott's disease, abscesses and new growths near the spine, inflammation and purulent collections in the pleuræ, mediastinum, peritoneum, and pelvis, may be the source of the meningeal thickening, which gives rise to symptoms mainly by irritation of the sensory and motor nerve-roots which pass through the area of disease. When the thickening becomes extreme, as it rarely does, it may be sufficient to compress the cord itself and give rise to pressure symptoms and the spastic paraplegia of a cross-myelitis. There is local tenderness over the spine, shooting or constant pains in the distribution of the irritated nerves, twitching of their muscles, hyperæsthesia in their cutaneous areas, which may go on to anæsthesia and muscular palsy if the nerves be sufficiently compressed or inflamed to cause their complete degeneration.

Anatomically, the dura is found hyperplastically thickened, with much adventitious fibrous tissue, and is frequently covered by a caseous or purulent deposit or involved in a new growth. The various findings, of course, depend upon the nature of the primary disease. When the thickening is extreme, the soft membranes are adherent to the dural tumescence and may be indistinguishable. The cord then shows a constriction, and may, in severe cases of long

standing, be very considerably reduced in size at the place of disease, with inflammation and degeneration.

The diagnosis is usually not difficult if the primary disease is recognized. It may be confounded with a myelitis, with which late in the case it is often associated; but the clinical history shows a preponderance of pain, spasm, and irritation, a chronic course, and an early absence of paralysis; while in myelitis the rapid onset, the absence of pain aside from the girdling sensation, and the promptly developed paralytic state with early bladder and bowel symptoms, are distinctive.

Owing to the serious nature of the causal conditions, the prognosis is bad and treatment is practically surgical. The pachymeningitis externa associated with Pott's disease is perhaps the least grave, as the proper orthopædic and surgical management of such cases frequently, in very marked instances, is followed by practical recovery, even when the cord has been notably compressed.

Pachymeningitis Interna.

Pachymeningitis interna, or internal inflammation of the dura, is described as hypertrophic and hæmorrhagic. In reality, these forms are but stages of one and the same process, the thickening and hypertrophy following upon the organization of the hæmorrhagic exudate; and the term hæmatoma of the spinal dura mater has been sometimes used. The condition is a rare one, and usually the cerebral meninges are similarly affected. It is most commonly found in general paralysis of the insane, and consequently is practically unknown in childhood.

The portion of affected dura presents on its inner surface a very considerable thickening, which may be a layer of reddish-brown exudate or consist of a lamination of fibrous tissue, the apparent result of the organization of successive hæmorrhagic exudations, and may attain sufficient size to constrict the cord. The softer, more recent, and reddish or brownish layers consist of fibrin and blood. Its distribution is frequently extensive, but in some instances it is confined to a comparatively short vertical extent of the spinal envelope, and is then more frequently situated in the cervical region. This circumscribed cervical form was first described by Charcot and Joffroy.

Syphilis, trauma, alcoholism, and exposure are regarded as competent causes, and hence it occurs, as a rule, in adult males, though some cases in children are recorded.

The condition is essentially chronic and of slow onset. At first, irritation of nerve-roots gives rise to local pain and hyperæsthesia over the spine and in the peripheral distribution of the spinal nerves of corresponding origin. This is followed, months or years later, by gradual loss of power, atrophy, and anæsthesia in the corresponding parts, and, as compression upon the cord is produced, spastic symptoms appear below, with increased reflexes, rigidity, and paraplegia leading to exhaustion and death. Some cases present stationary periods, and a few recoveries are claimed.

The diagnosis is difficult when a general distribution and cerebral symptoms are wanting. Diseases of the spine, progressive muscular atrophy, cross-myelitis, tumor, and external pachymeningitis must be excluded. An operation may be required to do this, and as it presents, except in syphilitic cases, the best chances of favorably influencing the condition and preventing destruction of the cord, in the desperate situation that is presented and with the courage given by asepsis, it may the more reasonably be resorted to early. Where syphilis is strongly suspected specific treatment should be persistently tried.

Acute Leptomeningitis.

Acute leptomeningitis, or inflammation of the spinal pia mater, is due to infection, usually involves the inner surface of the dura, and extends to the substance of the cord.

Etiology.—The infection of cerebro-spinal meningitis in epidemics of the disease falls sometimes only on the cord, and the infective nature of the attack is obvious. In those cases, however, that are attributed to exposure, "insolation," rheumatism, and other occult conditions, the infection is less readily comprehended, but in all probability is equally in operation, being favored by the physical conditions mentioned. The association of cases with septicæmia, pyæmia, and other infectious blood-states points to the same conclusion, and in the lymph and spinal fluid of these cases abundant pathogenic organisms have been observed. In some instances the spinal trouble is an extension from the cerebral meninges, the cervical portion of the cord being usually the only part involved. Injuries resulting in traumatism of the membranes by vertebral dislocations, strains, and severe concussions may incite a leptomeningitis over a limited area, from which it may extend or in which an infection may find a suitable field for development. Surgical operations upon the spine and penetrating wounds may afford access to and furnish the infection. Tuberculosis is a common cause, but the resulting meningitis is rather less acute, as is the case to a greater degree in syphilitic inflammation, which has a marked tendency also to remain localized.

Pathology.—The disease is usually of wide extent, the infection travelling rapidly through the arachnoid spaces, and finding in the spinal fluid an excellent medium for its propagation and extension. Congestion of the pia, of the adjoining inner surface of the dura, and of the cord, marked by increased vascularization and an increase of spinal fluid, passes into inflammation, with dulness of the membranes, opacity, thickening, and an exudation of large quantity, varying in color from an opalescent to a puriform, and of corresponding consistency. The microscope shows the diapedic elements of inflammation and often numerous bacteria, including at times those closely resembling the pneumococcus of Friedländer. Tubercles here correspond to their histological and bacterial characters on other serous surfaces. For a time the somewhat resistent pial covering of the cord and nerve-roots protects these structures, and especially in the purulent form of the disease; but usually the periphery of the cord and the roots show the inflammatory invasion, with corresponding changes in the nerve-fibrils, neuroglial framework, and vessels. In cases reaching a convalescent or chronic stage adhesions form between the cord and the dura, obliterating the arachnoid space over more or less extensive areas, distorting the nerve-roots, and sometimes changing the outlines of the cord itself, which, if softening in its substance has taken place as a result of the meningo-myelitis, presents degenerations of its conduction tracts and localized destruction of its gray matter. Large quantities of spinal fluid usually mark these late cases, causing, with the irregular adhesions, a sacculated condition of the dura.

Symptoms.—The abrupt onset of the disease may be preceded by a day or two of malaise and slight anorexia; but sometimes no invasive period is present, and a sharp chill is followed or attended by great pain in the back and darting pains around the body or down the limbs. In children, vomiting or convulsions may be present, and the former is a common symptom. Tenderness is at once developed over the spine, easily detectable, when not prominent, by the use of a sponge dipped in hot water or by sharp percussion with the finger. Spasm and rigidity of the muscles appear at once, causing stiffness of the neck

and back, sometimes notable retraction of the head; fixation of the limbs upon the body more or less marked, with a tendency to flexed attitudes; retraction of the belly from implication of the abdominal muscles; and sometimes difficulty of breathing, by involvement of the chest musculature aside from the dyspnœa, Cheyne-Stokes' respiration, and cardiac symptoms of medullary implication. The cramps in the muscles are painful, and yet tenderness and hyperæsthesia in the limbs prevent manipulations and passive movements. The rectum and bladder are the seat of similar spasms which may cause constipation and retention of urine, with frequent annoying and ineffectual expulsive contractions of these viscera.

Pulse and temperature are fickle, sometimes being subnormal, sometimes increased, and more often divergent; for instance, a subnormal temperature with an accelerated pulse. The lack of uniformity in their range is especially valuable in diagnosis, even when the cerebrum is apparently not involved. A temperature of 103° F. is not uncommon. Vaso-motor paralysis is usually shown by the vivid, persistent, but slowly-developed line which follows every stroke of the finger-nail or similar object upon the skin, and from the same cause the limbs may be congested and even slightly œdematous. At first, for a day or two, reflexes are inclined to be increased, and later may be wanting.

Cases which outlast the acute symptoms develop paralysis, anæsthesia, atrophy, and contractures in proportion as the cord and nerve-roots are affected. Paraplegia may result, presenting the features of a cross-myelitis with bladder paresis, bed-sores, increased reflexes, and spasticity. Symptoms vary with the location of the disease, but its tendency to involve the entire spinal apparatus is marked, and indications of its effect upon all spinal segments are to a greater or less degree present in a majority of instances. Some regions situated in the focus of the inflammatory action show early and emphatic involvement; those at a distance may be disturbed very little; and yet in some purulent cases, where the dural sheath is greatly distended through its entire length with the large accumulation, the pia protects the cord and nerve-roots from infection, so that pressure symptoms alone may be present.

Course.—Some cases terminate fatally within a day or two; others last a fortnight, and may then end fatally or recover. The nature and virulence of the infection are a determining factor, as is the location of the disease—extension upward or early involvement of the high levels of the cord tending to an early fatal issue. Complete recovery is rare, and the conditions resulting from myelitis are of long duration, and may even last a lifetime. The tubercular and syphilitic varieties, as already indicated, less rapidly run their course, and the latter is capable of material modification by treatment.

Diagnosis.—The diagnosis depends upon the rapid onset, the pain in the back, the radiating pains, the rigidity, the increase of pain on voluntary movement, the hyperæsthesia, and the fickle temperature and pulse. From myelitis it is distinguished by the paralysis and lack of pain which characterize the cord lesion, but the frequent association of the two is to be always kept in mind. Hæmorrhage into the subdural space, from the irritation of the nerve-roots, presents very similar symptoms, but is extremely rapid in the onset, usually following traumatism or a strain, and develops meningitis in a short time thereafter. Hæmorrhage into the spinal cord gives instantaneous symptoms and immediate paralysis, and is practically devoid of pain. The rigid form of tetany may present a very close counterfeit, but its long duration, remissions, and amenability to spinal sedatives, with absence of spinal tenderness and shooting pains, and with the possible history of previous attacks and the usual irritability from pressure upon nerve-trunks and arteries, should differentiate it. Tetanus

may be mistaken for spinal meningitis. The early trismus, the excessive hyperæsthesia, the fever of onset, the paroxysms of spasm, and the frequent history of traumatism point the way to diagnosis. Muscular rheumatism and strain present a very superficial resemblance.

Prognosis.—The outlook as to life is always serious and grave in proportion to the acuteness of the onset, to the virulence of the infection, to the implication of the upper portion of the cord, and to the height of temperature. The estimate is also to be guided by the previous condition of health and the age of the patient, children and the aged quickly yielding to the disease. Traumatic and surgical infection is less serious than auto-infection by leucomaïnes. The possibility of the removal of sources of infection cuts some figure as to ultimate results, providing the patient survives the acute stage. The late results, due, for the most part, to permanent changes in the cord, are usually beyond the hope of marked improvement.

Treatment.—Complete and absolute quiet is to be insisted upon, and the patient maintained upon the side or face, if possible to do so without increasing the cramps. The partial knee-elbow position over a mound of firm pillows will often be found very comfortable, and at the same time will afford the best opportunity for local applications. These at first should be strongly counter-irritant, as the thermo-cautery, blisters, or detergents like leeches, vigorous dry-cupping, or wet-cups in robust or plethoric individuals. Should myelitis be associated, less active measures are indicated, and the skin must not be broken or highly irritated, owing to the tendency to bed-sores. A hot bath and pack at the onset with active catharsis have seemed to do good. Sedatives, especially spinal sedatives, are frequently required to control the spasms, and anodynes to relieve the pains. A thorough course of mercurial inunctions over the spine has strong advocates, the quantity used being sufficient to produce slight ptyalism. Owing to the reflex irritability, these rubbings must often be impossible, and the therapeutic value of mercury in the acute stage of non-luetic cases is open to question. Iodide of potassium and ergot are also at this time of little or no value. The ice-bag to the spine is one of the most serviceable measures, but is rarely tolerated long by the patient, and its intermittent application is useless. It should always be tried. As the active stage subsides, light cauterizations with the Paquelin apparatus, mild sinapisms applied for six or eight hours, and the hot spray douche seem to assist the reparative efforts of nature. Cerebral symptoms usually mean the implication of the brain coverings, the spinal features become of secondary importance, and the treatment is that of cerebro-spinal meningitis. The paralysis, contractures, and other late results of the myelitis are to be managed in accordance with the rules of practice in that disease.

Chronic Leptomeningitis.

The chronic form of inflammation of the soft membranes is usually the sequential stage of an acute attack, but may follow alcoholism, syphilis, or tuberculosis. Its origin as a primary affection is open to some doubt, but a very slowly-developed leptomeningitis may follow concussion, though it is impossible in such a case to exclude immediate slight histological injuries of which the later inflammation is a natural development. The formerly much-used term "chronic meningitis," which was given to every group of obscure subjective symptoms referable, however remotely, to the spine, only needs mention to be condemned.

The symptoms are practically those of the acute form much reduced in in-

tensity, and are dependent upon similar causes. Pain in the back predominates, and spasm is insignificant or absent. The radiating neuralgic pains are especially pronounced, and paræsthesiæ are prominent. Their distribution depends upon the nerve-roots involved and the location of the inflammation, which is much more circumscribed than in the acute form. The late manifestations are those due to neuritis originating in the roots, and myelitic symptoms are comparatively infrequent.

The anatomy of the disease is very little known, as opportunity for post-mortem examination rarely occurs, but a more or less extensive fibrous thickening may be found, and adhesions between pia and dura which constrict the nerve-roots and may girdle the cord. Degeneration of the spinal nerves traversing the lesion is not rare, and this accounts for the herpetic and other cutaneous symptoms of neuritis which are occasionally noted.

The prognosis will be guided mainly by the effect of treatment, but a complete recovery is very rare. Each case must be carefully estimated by itself.

The treatment in syphilitic cases consists in the heroic management of that disease, and iodides and mercury are also the most efficient drugs in non-luetic cases. General measures are of avail, and persistent counter-irritation over the spine is the most valuable local measure. Sometimes rest in bed and the ice-bag to the spine are of distinct value. Sedatives and analgesics are often required.

II. MYELITIS.

Myelitis, or inflammation of the spinal cord, is a generic term covering a condition presenting many varieties of a more or less arbitrary character, depending upon the mode of onset, the portion of the cord involved, the duration of the disease, and the exciting cause. Thus it is acute, subacute, or chronic; transverse, diffuse, focal, disseminated, central, or annular; parenchymatous or interstitial; and compressive, traumatic, secondary, syphilitic, infectious, etc., the adjectives sufficiently describing the modifications. The forms of myelitis constituting the so-called system lesions, poliomyelitis, locomotor ataxia, and other circumscribed scleroses, are described under separate headings. The clinical variations of the disease are multiform. So widely do the several tracts and segments of the cord vary in function that their implication gives rise to the most diversified symptomatology, for the comprehension of which a fair knowledge of the anatomy and physiology of the cord is requisite.

Acute Myelitis.

Acute Myelitis, acute softening of the cord or transverse myelitis, is the most ordinary form, and not a rare disease.

Etiology.—While the disease may appear at any age, it is very rare in children; males from eighteen to forty years furnish the large majority of cases, syphilis, exposure, and muscular effort playing an important part in precipitating the malady. Next to trauma, syphilis is the most frequent cause. Benedict and Erb, indeed, are disposed to assign to the syphilitic cases a clinical entity; but the only variations are those attributable to the infection, the nature of the syphilitic process, and its partial response to treatment in some cases. Lead, mercury, and other chemical poisonings are at times provocative of myelitis. Acute infections, sapræmic and pyogenic conditions, may lead to it, the last sometimes producing an abscess of the cord. Pressure from hæmor-

rhage, pachymeningitis, tumors, fractures, dislocations, and from Pott's disease, very rarely from a thoracic aneurism, may incite it, and it has been attributed to sexual excesses. Wounds of the cord or in the neighborhood leading to infection, minute hæmorrhages in the cord from strains, violence, concussion, and arterial disease, thrombosis or embolism, may originate the softening. Whether concussion unattended by immediate histological injury to the cord is capable of producing myelitis or not is a mooted question, but the growing tendency is to look upon the material and anatomical factors as requisite to its development. The annular form, and sometimes other varieties, are due to extension from a meningeal inflammation.

Pathology.—The inflammatory process may be very slight or absolutely destructive in intensity. If the lesion be examined early, there will be found hyperæmia and swelling of the adjacent pia mater and of the affected portion of the cord. Later, the condition depends largely upon the amount of blood effused; in some instances the disintegration of the cord is such, and the extravasation of blood so considerable, that the gross characters of a clot only are found. In other cases softening is so pronounced that the cord is diffluent and of a creamy consistence and appearance. From the hæmorrhagic element "red softening," comparable to that in the brain, may be found, and this, by the resorption and change of the coloring matter, later becomes yellowish. In time the affected area, through the removal of the fat and the deposition of adventitious fibroid elements, looks grayish and translucent and is shrunken in outline. Thus, after some lapse of time, the cord may be reduced to a narrow filament. In these prolonged cases upward and downward, secondary, sclerotic degenerations in the white columns ensue.

Peripherally, the muscles innervated by the involved cord-segments rapidly waste and degenerate, and dystrophic bed-sores are common even at an early stage. Implication of the nerves controlling the bladder frequently results in cystitis, leading to nephritis and uræmia.

Microscopically, the findings vary greatly with the intensity, form, and duration of the disease. When the cord has become entirely disintegrated and diffluent such examinations are of little value. In the mildest forms the vascular changes are the most noticeable, the blood-vessels being widened, crowded with the formed elements of the blood, and the perivascular spaces greatly distended with leucocytes. Minute extravasations are common. The gray substance of the cord is more granular than in health, its cells distorted, swollen, and devoid of processes when the condition is marked. Corpora amylacea and globules of myelin are common. In the white portions increase and alteration in the neuroglia are found. Spider-cells are frequent. The fibres show swelling of the axis-cylinder, and the myelin has a tendency to break up. At points of pressure the fibres are shrunken and may entirely disappear. In the parenchymatous forms the nerve-cells present the principal changes, the intercellular substance and interstitial material showing practically no change, and the vascular condition is less marked.

In cases of long duration both fibres and cells give place, in large part or completely, to an actual increase in the fibrous elements of the interstitial structure, and new fibroid tissue is deposited. The resulting ascending and descending degenerations show sclerotic features similar to those in the system lesions, and sometimes a more active inflammatory process extends a short distance up or down the cord, occasionally following the central canal, which may show dilatation, proliferation of the epithelial lining, and more or less distortion.

The distribution of the inflammation in the cross-section of the cord is

subject to no rule. In some cases it is scattered in random foci, in others confined to a few principal points ; or the entire cross-section may be involved, and the gray matter does not, relative to its proportions, seem to be especially selected.

Symptoms.—The onset, except in traumatic cases, is gradual, but in the course of a few hours or days or weeks paraplegia may become complete. Very rarely, and usually only in syphilitic forms and those due to slowly-developed pressure, there are prodromata for weeks or months before the attack, consisting in temporary weakness, tingling and radiating pains ; but ordinarily a feeling of numbness and weakness in the legs is experienced, the lower extremities feel heavy and unmanageable: in a few hours they refuse to bear the weight of the body, and in a few days may become completely paralyzed. During the first week the temperature may be elevated a degree or two, but very rarely attains a height of 104° F. Delirium and convulsions have been seen occasionally in children, and more rarely in adults. The reflexes, where directly related anatomically to the affected segments, are lost early and permanently, and below that level are increased after a few days, unless the cord has been entirely destroyed at the inflammatory focus, when they are abolished. Provided the posterior roots and meninges are involved, pain in the back and limbs is a prominent symptom, but rarely is of an excruciating character at the onset. At the upper level of the inflammation some pain is the rule, which gives rise to a band or girdle sensation and a zone of hyperæsthesia about the abdomen or chest. This sign, with the paralysis, definitely localizes the upper limit of the lesion, but if it be in the lower cervical region this sensation passes down the arms and is not so sharply defined. Lesions in the cervical region are also marked by implication of the cilio-spinal centre, with consequent dilatation of the pupil. Continuous priapism is then, too, a usual occurrence, and the intercostal muscles and heart may be affected. Below the lesion, and depending upon its intensity, there are variations in sensibility to all forms of stimulation, from slight blunting to the usually complete anæsthesia. Sensations of drowsiness and aching in the paralyzed and anæsthetic limbs are sometimes mentioned; and cramps and drawing up of the limbs frequently occur early, and later are the rule. Distinct muscular atrophy related to the portion of the cord

Fig. 1.



Showing Flexion, Cross-leg from Adduction, Contractions causing Drop-foot and Bed-sores.

affected takes place, but in the trunk is not readily discernible. The paralyzed limbs during the first few days are abnormally warm, but soon present a subnormal temperature: sluggish circulation and emaciation ensue, with œdema of the feet and legs if the limbs are left any length of time in a pendent position. If the lesion is low down, the atrophy is a marked feature and the re-

action of degeneration is present. Under the influence of pressure bed-sores form on prominent portions of the body and limbs, and this very early. In some cases within the first week immense sphacelization may take place over the sacrum, which cannot be explained by pressure and the moisture from the urine, but implies a dystrophic condition of cord origin. Bed-sores of this nature are especially liable to form when the lumbar cord is the seat of the disease.

Course.—The onset, as already indicated, is moderately rapid, as a rule, and in the course of a few days the complete picture of paraplegia is presented. Although the case may stop short of this at any point, it may, on the other hand, rapidly progress to the formation of bed-sores, the development of cystitis, and rapidly progressive exhaustion, often terminating in a fatal issue. Non-fatal cases come to a standstill after two or three weeks, and if nutrition and strength are maintained improvement slowly takes place, sensation and motion gradually reappearing and increasing for a year or two. A complete, or apparently complete, recovery is rarely seen. For the most part, secondary degenerations, upward in the posterior columns of the cord and downward in the lateral tracts, cause inco-ordination on the one hand and spastic symptoms on the other—a combination suggestive of ataxic paraplegia, and no doubt sometimes confused with that disease. The implication of the pyramidal tracts leads to the spasms, tremors, and cramps which form such prominent features of these late cases, and gives rise to the spastic gait when walking is pos-

Fig. 2.

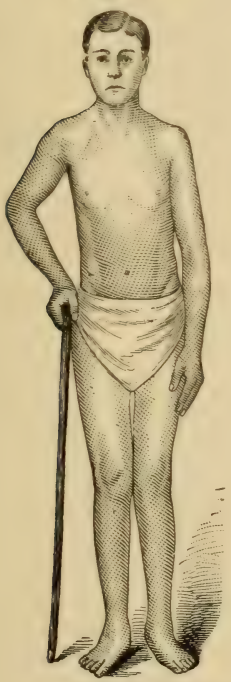


Fig. 3.



Chronic Myelitis, showing station and rigidity, with partial flexion and adduction of thighs.

sible, and to the flexed limbs, adducted thighs, and crossed legs of the bed-ridden cases, as shown in Figs. 1, 2, and 3. In these later stages the condition is often spoken of as chronic myelitis.

Diagnosis.—Regarding the location of the lesion, the best guide will be the upper level of anæsthesia and the hyperæsthetic girdle. After a few weeks increased superficial and deep reflexes occur below the disease, while those reflexes whose arcs are involved in the softening disappear. Thus, if the umbilical or mid-abdominal reflex is absent, those below being present and exaggerated, and a girdle sensation is present just above the navel with anæsthesia below, the lesion is at the tenth dorsal segment and opposite the body of the ninth dorsal vertebra, the guide to which is the eighth dorsal spine. With this the distribution of paralysis should also agree.

The intimate and usual association with myelitis of some more or less localized meningitis is to be constantly in mind, as the obtrusive symptoms arising therefrom may serve to very much embarrass the diagnosis, especially in the beginning, and mislead the judgment as to the future of the case. The nature of the lesion must be determined by a careful study of the clinical history and a careful clinical examination of the patient for spine disease, for neoplasmata in other locations, for tuberculosis, for syphilis, and for injuries.

Prognosis.—While the prognosis is always grave as to ultimate recovery, and early in a given case must be carefully guarded as to the probability of a fatal termination, there are certain facts which modify the estimate. A dorsal myelitis is less serious than a lumbar, and very much less than a cervical involvement. The more sudden and complete the onset, the greater the probable damage to the cord. High temperature and early bed-sores are extremely ominous. Serious involvement of the bladder and bowel, implying lumbar cord lesions, are distinctly unfavorable. The reappearance of sensation in the anæsthetic area is hopeful, and usually followed by some return of voluntary motion. When improvement has distinctly commenced, it may be expected to continue for a year, and progresses even two years or more in some instances. Secondary degenerations mean an ataxic paraplegic condition. Myelitis depending upon Pott's disease or upon pressure may reasonably be expected to make a fair recovery if the causal condition can be removed. Indeed, it is marvellous to what an extent the cord may be slowly compressed, and eventually regain functional activity with disappearance of all the paraplegic symptoms. When the myelitis is due to active syphilis or to pressure by a syphilitic neoplasm, some considerable improvement under treatment is the rule, but an absolute recovery the extreme exception. This is especially true when the luetic lesion is confined to the cord itself.

Treatment.—The patient should be put at once to bed, and kept on the side, or, better, when possible, upon the face. This can usually be accomplished by building up a mound of pillows under the thorax and abdomen. In this position the bowels and bladder can be readily evacuated and the patient easily managed. A brisk cathartic should be administered and the bladder carefully watched, the catheter being avoided as long as possible, and used under the strictest rules of cleanliness when finally it is necessary. The tendency to retention of urine, with cystitis, and its unfavorable significance, cannot be too much insisted upon. To the spine counter-irritation with mild sinapisms is desirable. Here the dystrophic tendency must be borne in mind, and blistering or severe irritation below the line of inflammation absolutely avoided. A mustard plaster four inches wide and two feet long, made of one part mustard to ten of flour and thoroughly mixed, can be applied for hours and with benefit. The use of ergot and other drugs to control the circulation is of doubtful value, but may be tried if the stomach is tolerant. The mechanical causes of the disease must be met surgically. When present, except in syphilitic cases and Pott's disease, nothing but operation promises any reason-

able relief, and operation under strict aseptic methods adds practically nothing to the gravity of the situation. When bed-sores appear or the tendency to their formation is marked, a water- or air-bed kept at a proper temperature is useful, but, unfortunately, is rarely available. Great care to protect the skin from discharges and uncleanliness of all sorts, with frequent applications of alcohol and unirritating dusting powders, and repeated changes of position, will do very much to obviate these dangerous complications. After ten days or two weeks systematic passive movements, massage, and the use of faradic electricity should be adopted to prevent the wasting and tendency to contracture. When, later, the contractures may be very prominent, splints should be employed. As sensation and slight voluntary motion return, a carefully guarded system of mild exercises should be instituted. The intelligent use of the faradic wire brush to the anæsthetic parts sometimes is of distinct benefit in hastening sensory improvement, which in turn is usually followed by more or less volitional activity.

Some syphilitic cases yield promptly to large doses of iodide of potassium and mercury, and nearly regain the condition of health. A certain residuum of impairment is always left, however, when the cord has been actually invaded. Other cases fail to respond to this line of treatment even when heroic doses are employed. One should not be satisfied in an adult to stop short of an ounce of iodide a day if smaller doses fail to make an impression, and by guarding the stomach with Vichy and the bowels with bismuth this can usually be accomplished without much difficulty. In children the dose must be proportioned to their age.

The bladder and bowel, except when the lumbar centres are destroyed, tend to regain some power and control, which can be assisted by rendering their contents unirritating and by encouraging regular habits regarding their evacuation, with the use of faradization to strengthen the sphincters. Everything conducing to the general healthy tone of the individual assists directly and indirectly the local disability.

Chronic Myelitis.

Chronic myelitis is usually the terminal stage of an acute softening, and but very rarely, if ever, is a primary condition. Its separate consideration is only warranted by the fact that it is often mistaken for primary spastic paraplegia, for ataxic paraplegia, rarely for locomotor ataxia, and that its treatment requires description. Its diagnosis depends on its long duration and the history of an acute, or at least tolerably rapid, onset, on the involvement of bladder and bowels, on the paraplegic distribution of sensory and motor deficiency and wasting, on the absence of pupillary symptoms, lightning pains and inco-ordination, on the presence of rigidity, increased reflexes and contractures, and on the evidence of old bed-sores.

The treatment consists practically in the use of everything that will elevate the general tone; in guarding against bed-sores, cystitis, contractures, and wasting; in the use of massage, electricity, hot and cold spinal douches, and counter-irritation in the form of flying blisters and the thermo-cautery; in operation for pressure conditions from tumor or bone; in appropriate suspension and fixation in Pott's disease; in the persistent use of antisyphilitics in luetic cases, and in operation when these do not succeed or a gummy tumor is reasonably suspected. Exercises to develop the impaired muscular power, passive movements, and volitional efforts against resistance are valuable. The sphincteric paresis can also be improved by the passive and active movements

recommended by Brandt in prolapsus uteri, which serve to strengthen the pelvic floor, and consist for the most part in having the patient adduct and abduct the flexed thighs while lying on the back and raising the pelvis from the bed, the motions being resisted by the attendant. Continued and often-repeated voluntary attempts to contract the sphincters, as in restraining fæces, should be encouraged. Late in the disease, when it has become stationary, tenotomies and appropriate apparatus may enable an otherwise bed-ridden patient to get about. The tendency toward some improvement during the first two or three years should be kept in mind, and everything done at this time to assist the reparative efforts of nature.

ACUTE ANTERIOR POLIOMYELITIS.

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Acute Anterior Poliomyelitis, also known as myelitis of the anterior horns, atrophic spinal paralysis, infantile paralysis, or the essential paralysis of children, is a febrile disease the activity of which falls upon the anterior horns of the gray matter of the spinal cord; it is marked by rapidly developed and extensive paralysis, a portion of which remains permanently, and is usually followed by atrophy of muscle and often by non-development of bone, and by deformity.

Etiology.—It is a disease almost peculiar to childhood, and, though cases occurring in adult life have been recorded, it is probable that many of these late instances have been cases of peripheral neuritis, the diagnosis of which has only of late years been generally made. The great majority of cases occur before the tenth year of age, and three-fifths are encountered before the fourth year, being equally divided for the first three years of life. As it is comparatively rare during the first six months, the latter half of the first year of life is therefore the most susceptible period. The coincidence of the first dentition at this time has given an altogether undue importance to the rôle played by the eruption of teeth as a probable cause. At one time exposure to cold was considered an active etiological factor, but Sinkler of Philadelphia found that over four-fifths of all cases occurred during the hot months from May to September inclusive, with a heightened frequency during the hottest months, July and August. Heat may therefore be considered as a predisposing or favorable condition for the evolution of the malady. It is to be remembered, however, that slight colds among children are as frequent in warm weather, from draughts when lightly clad, as in winter. In nearly every case the history of a fall or blow of some sort is brought forward by the parents, too frequently resulting in casting unmerited blame upon the nurse or others in charge of the child. It must, of course, be admitted that a concussing force applied to the spine might lower resistance to the disease, but there is no good reason for attaching great weight to slight traumatism. In a numerous list of instances the disease is said to have followed acute diseases, such as the exanthemata, but in many such cases the initial fever of the poliomyelitis was probably mistaken for some other complaint, and a careful study of these reports reveals such a lack of detail that they must, as a rule, be accepted with caution. In others the original ailment is stated to have been obscure or atypical, and as a matter of fact the diagnosis of anterior poliomyelitis is very difficult during the initial fever, and, until paralysis is apparent, differs but little from the febricula of indigestion or other slight ailments.

Pathological Anatomy.—It is only since 1865 that the lesion in this disease has been known. In that year Provost thoroughly described it, and his findings have been invariably confirmed by workers in this field. Owing

to the fact that only rarely does death occur in the very early stages of the disease, or is then attributed to other causes, the initial appearances and conditions are practically unknown, but can from later observations be fairly well indicated. As a rule, the anatomical changes are limited to the anterior horns of gray matter, only involving the neighboring white tracts of the anterior and lateral columns by the extension of the inflammatory or hæmorrhagic processes which take place in the cornua, and which result in a softening and disintegration of their elements. The large motor and trophic cells either completely disappear or only a few shrunken representatives are left; in milder cases slight alterations in the cells alone are found. Later, from the shrinkage of the neuroglial tissue and from the deposition of other fibrous elements, a depression is found in the implicated part of the cord, and granular disintegration of the involved nerve-elements is present. When the pyramidal tract is involved, descending degeneration may take place, though this is uncommon, and when present is usually slight in transverse extent. The muscles depending for innervation upon the affected cornual cells rapidly waste, and the sarcode elements in extensive cases entirely disappear, nothing but the fibrous tissue being left. In less-pronounced cases individual fibres or groups of muscle-bundles are destroyed, or sometimes merely a diminution in size is found; and rarely isolated muscular fibres are encountered which show a true hypertrophy, probably of a compensatory character. Where the bones are affected, they are smaller, smoother, less well marked by muscle insertions, more compact, showing less cancellated structure, and are consequently more fragile.

The peripheral nerves arising from the affected anterior horns show degenerative changes of a corresponding degree. Sometimes in extensive cases nothing but fibrous cords are left, but usually all the fibrils are not destroyed, the cross-section of the nerve-trunk showing many normal elements. This, of course, is to be expected, as the sensory fibres which enter the cord by the posterior root are not implicated in the central lesion; but the same is true of sections of the anterior roots close to the cord, and the sympathetic fibres in the anterior roots also escape. Examinations of the brain are usually negative. In some extreme cases of extensive peripheral distribution of long standing the corresponding cortical motor area has been found smaller or undeveloped.

A number of cases are on record in which an acute polyneuritis has apparently coincided with the spinal attack, but these cases require more study, and the presumption is that the tenderness in the nerve-trunks in such cases is due to the degenerative process in the motor-fibres and the attending irritation of the adjoining sensory bundles which furnish the nervi nervorum.

Pathology.—The acute onset, the short duration of the fever, its comparatively uniform range, and the immediate paralysis point to a systemic infection, or, to adopt the expression of Gowers, "a blood-state," which finds its local expression and its anatomical manifestation in the anterior spinal gray matter. The elective action of certain drugs upon the spinal centres leads naturally enough to the supposition that a ptomaïne or leucomaïne might have a similar selective tendency, as, for instance, that of diphtheria is known to have for the peripheral nerves, or of hydrophobia for the central apparatus. This idea receives some support from instances in which more than one case occurred at the same time in a given family; and several practical endemics of the disease are on record. The whole question is yet undecided, but the infection theory would seem to be the best working hypothesis.

Symptoms.—Usually without apparent provocation the child is found to be feverish and ill. A temperature of 100° to 102° F. has been frequently noted, and this febrile invasion-stage lasts from a few hours to a few days, when

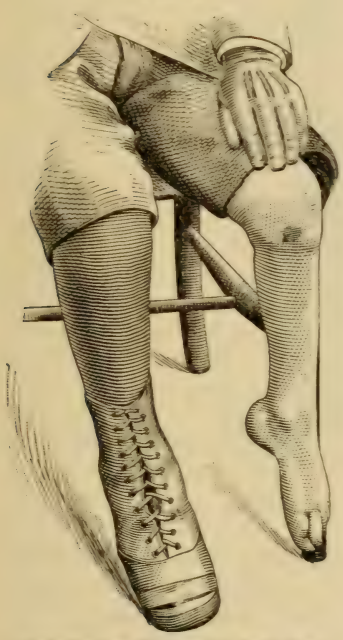
paralysis and flaccidity of one or more limbs are detected. It is not rare, however, for the child to go to bed apparently well and to awake paralyzed in the morning. The febrile movement may be attended by vomiting and diarrhœa, by convulsions of a generalized character, or by delirium and diffuse cerebral manifestations. As soon as the paralysis is noted the case is usually recognized. Most writers state that rarely there is a complaint of pain in the afflicted members, but the rule is that sensation in all its phases is entirely normal. It is probable, however, that early dysæsthesia, owing to the age of the patient and a lack of careful search for such difficulty, has been many times overlooked. In some considerable number of cases during the initial fever handling of the affected limbs provoked outcries, which were not elicited by similar manipulation of the other members; and it is likely that more attention in this direction will show localized hyperæsthesia or some kindred state to be usually present and of diagnostic importance. Indeed, complaints of pain and formication have been generally noted in cases of a comparatively advanced age, lending perhaps undue weight to the supposition that such cases are not of a true spinal type. The sphincters are almost never relaxed, so that control of the bladder and bowel remains unimpaired, but in the rare cases in which these sphincters are relaxed there is more or less apparent loss of sensation, the extent of the lesion is greater, and the prognosis is extremely unfavorable.

FIG. 1.



Leg Type, with Marked Calcaneus.

FIG. 2.



Anterior Leg Type, with Drop-foot.

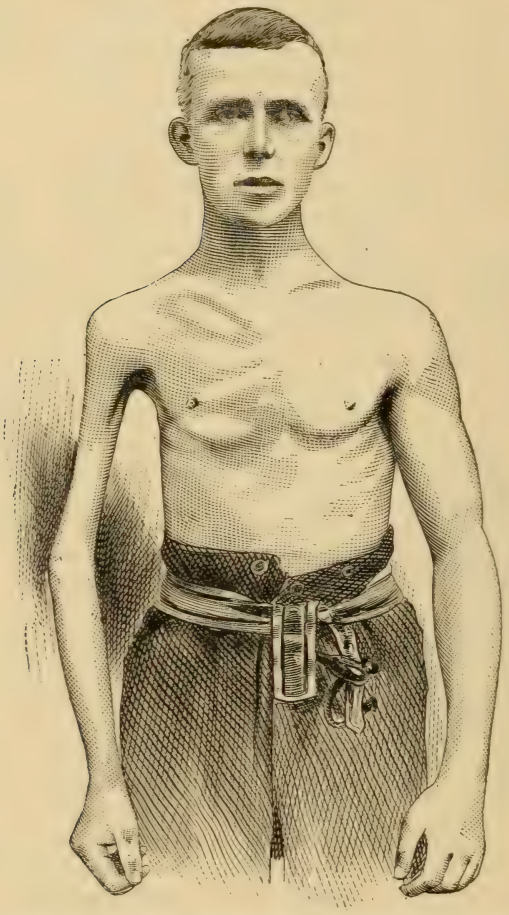
Even in fat children the implicated muscles can be seen, after a few weeks, to have wasted, and, if tested with the faradic current, either do not respond at all or show a remarkable diminution in their excitability. At this time the patient will have begun to show considerable improvement, the motor paralysis remaining complete only in the parts that are to permanently suffer, and a gradual improvement may be reasonably expected to extend over several months. In the muscles showing lessened faradic excitability galvanism produces exaggerated responses as compared with the sound limbs; and the complete reaction of degeneration or any modification of it may be encountered. In a well-marked case faradism fails by the tenth day, and the galvanic increased response appears, lasting for about six months, when it gradually fails. At this point faradic excitability returns, and the muscle regains something of its size and strength; or, if too seriously impaired, faradic response does not reappear, galvanic response disappears, and the muscle is irretrievably lost.

The reflexes are lessened or abolished in proportion as the muscles which are anatomically associated with them are involved; or perhaps it would be better to say that their alteration depends upon the implication of the cornual

cells making up a part of their arc. Bones which have not attained their full growth are retarded or fail entirely to develop if their trophic centres are implicated.

The seriously atrophied muscles become unyielding fibrous bands; and since they offer to the synergic and antergic muscles neither assistance nor opposition,

FIG. 3.



Shoulder and Arm Type (Kindness of Drs. Ridlon and Jones).

distortions soon develop with joint-changes and sometimes subluxations. Joints which depend upon muscular support, as the shoulder, may allow of so much deformity by the relaxation of the muscles which have lost their tonicity that the articular surfaces widely separate. The skin is inactive, often cold, and sometimes dry and scaly, but the atrophic conditions so usual in neuritis are practically absent, and bed-sores are almost unknown.

The distribution of the permanent paralysis and wasting is characterized by non-conformity to any type, and the resulting deformities are therefore of all grades and descriptions. The lower extremities are affected about three times as frequently as the upper, and the left leg twice as often as the right. A crossed form, in which the upper extremity on one side is involved with the opposite lower limb, is not rare; but involvement of both limbs on the same

side is extremely uncommon. In the lower extremity the extensors seem more susceptible than the flexors; hence drop-foot, with equine talipes, flexed knee, and flexed thigh are common. When the paralysis is below the knee the sural muscles usually escape. In the upper extremity the most frequently encountered wasting is in the small muscles of the hands, the deltoid, and the extensors of the wrist—the biceps and supinators generally escaping. For the most part, the central lesion is confined to the cervical and lumbar enlargements; consequently the body muscles usually are spared, and involvement of the cranial nerves is so rare as to always raise a doubt regarding the diagnosis.

Course.—The course of the disease may be clinically divided into (1) a stage of febrile invasion, lasting from a few hours to a few days, with local tenderness and rapidly developing and increasing paralysis; (2) a stationary stage, lasting for several weeks; (3) a period of improvement, lasting to the end of the year; and (4) a stage of permanent disability for the remainder of life. Relapses during the early weeks have been recorded in very rare instances, and second attacks are still rarer. Among the sequelæ the spastic contractions, dislocations, and deformities have been already mentioned. The fragility of the bones makes them liable to fracture, but union takes place with ordinary promptness under proper fixation.

Diagnosis.—In the early stages of fever, before paralysis has appeared, the diagnosis is usually missed except under rare epidemic conditions, and the termination of an apparently trivial ailment in extensive paralysis is frequently the cause of much chagrin on the part of the medical attendant, who may have expressed, naturally enough, a favorable prognosis. As already indicated, the initial fever may be readily mistaken for that of general disorders, and sometimes, though rarely, the pain in the limbs leads to the idea of rheumatism. If, however, the possibility of anterior poliomyelitis be in mind, and examination discloses some slight local tenderness or diminished muscular activity, or both, a guarded opinion will naturally follow. It is only when the paralysis is developed or is developing that the nature of the disease becomes certain, and even now, if there have been cerebral symptoms, such as delirium or convulsions, difficulties are not at an end. The cerebral palsy of children is almost invariably ushered in by convulsions, but these have a definite distribution involving one side or one limb, or only the face, while the convulsions of the disease under consideration are generalized. Localized pain from traumatism or inflammation may cause immobility of a limb, and when preceded by a fever gives rise to doubt; but the usual, indeed, almost invariable, absence of extreme sensory troubles in disease of the anterior horns is a distinguishing feature, while the local conditions can be otherwise made out. After a few days the electrical test gives absolute data. Faradic response is abolished in no other disease so early; even in severe neuritis it is longer maintained, and is then attended by a very marked sensory disturbance, which also usually precedes it for a long time. A few careful applications of the induced current at this period can do no harm. Diphtheritic palsy presents the history of the throat affection, and the involvement of the palate and muscles of visual accommodation is distinctive.

Prognosis.—As far as life is concerned, this disease terminates fatally very exceptionally, and if the patient survives but a short time the onset of the paralysis, life may be considered out of danger. Further, one can say with a reasonable degree of certainty that the paralysis at first developed will notably recede, but, unfortunately, it is equally certain that a portion of it will permanently remain. At the end of a fortnight a carefully conducted faradic examination of the muscles enables the physician to speak more specifically

regarding the amount of permanent disability. At that time any muscle which responds, however feebly, may be expected to regain a fair degree of its former tone and strength, while those that do not respond even to strong currents are not necessarily beyond hope of slight improvement. Even after several months faradic stimulation, at repeated intervals, of a, at first, perfectly inactive muscle may develop some contractility, and this is of favorable import for the given muscle. The extent of permanent paralysis governs the amount of resulting contracture and deformity; and likewise the retardation of development of the limb and of the bones is in similar relation. The anticipated amount of these deforming conditions will have a bearing on the probable general activity of the individual, his prospective physical health, and liability to fractures. Finally, the outlook is modified by any cachectic state, as tuberculosis, rickets, or syphilis.

Treatment.—Owing to the irregularities of the course of this disease in various cases, and its natural tendency to improve up to a certain point, it becomes a matter of great difficulty to estimate the value of any therapeutic agent or mode of treatment. In the early stage, as soon as the diagnosis is made—and that is usually as soon as the palsy is recognized—if fever still continues there is good reason to suppose that antipyretic antiseptics like the salicylates, or even bichloride of mercury, would do good. To the spine hot applications can be made if the circumstances of the patient will assure their intelligent and faithful employment; otherwise they are worse than useless, and very mild sinapisms can be more properly used. The child should be kept on the side or face, and the affected limbs should be thoroughly enveloped in cotton-wool to maintain the circulation and the nourishment of the muscles in the parts laboring under diminished trophic influence. The use of stimulants like strychnia or electricity while the lesion is active is to be strictly avoided; but when the active process has come to a standstill—that is, ordinarily at the end of a fortnight—the systematic use of electricity is one of the most important measures. Its object, however, should be thoroughly understood, and some occult influence on the central lesion or the peripheral nerves should not be expected of it. Its usefulness consists in maintaining the nourishment and normal contractility of the muscles which are temporarily deprived of their natural trophic and motor control, so that, as the inflammation subsides and the widespread inhibitory effect of the local lesion recedes, the central apparatus may find the muscular periphery in the most favorable state to respond to its enfeebled influence. For this purpose, as faradism is early abolished, the interrupted galvanic current must be used, the slightest intensity being employed that will cause a contraction, and care must be exercised not to unduly fatigue the muscles. A dozen contractions at most should be elicited at one séance, and often only one or two can be provoked by a strength of current that is bearable. Care not to alarm the child is imperative, as a daily struggle will probably do more harm than the electricity will do good. It is well to commence with dry or wet sponges alone until the young patient is accustomed to the manipulation. As the muscles often react better and with less pain to the positive pole than to the negative, it is well to have for the negative electrode a broad sponge which can be placed on the sacrum or breast, and with a smaller positive sponge the muscles can be exercised. Applications of galvanism through the cord are quite useless, and even if such currents reached the lesion, which is doubtful, their effect for good is questionable.

Later on, as faradic response returns in the muscles only slightly affected or temporarily inhibited, this form of electricity is efficacious for the purpose of local stimulation, and the presence of this reaction in any muscle is always, as

already indicated, a gratifying circumstance. To entrust electrical treatment to the parents, however intelligent they may be, is a mistake.

In the same way, local frictions and salt baths, warm wrappings, and massage are valuable measures which can be more rationally entrusted to parents or nurses who take an intelligent interest in the work. The moment a group of muscles weaken, the limb tends to assume an abnormal position, and it is very highly important to meet this tendency from the very first moment, even in cases where there is every probability that the paresis will recede. It can be easily accomplished by means of the warm wrappings, or even by the application of light apparatus. There can be no question that recovering muscles will find their task much easier if their proper relations have been maintained, and unbalanced muscles will be much less liable to contractures if an artificial balance has been provided and joint surfaces have not been altered by vicious positions long maintained.

As soon as the permanent paralysis can be fairly well foretold, massage should be especially directed to obviate the contractures and deformities that ordinarily result, as indicated by the anatomical knowledge of the physician. Stretching of the unopposed muscles by passive movements of the joints will accomplish much, and the moment a tendency to contracture is perceived the case becomes one for permanent mechanical appliances. The tendency to equine talipes, for instance, can be met by a slight elastic cord from the toe of a shoe to a band at the knee; and more elaborate orthopædic apparatus should be employed at the knee and hip if required. These cases are, therefore, practically orthopædic troubles from the very first.

Nearly all the improvement that is to take place in the muscles will have developed by the end of the first year, and what is slowly gained subsequently in this direction is quite independent of any treatment whatsoever.

The treatment of a late or neglected case is practically surgical. Shortened tendons may be cut and joints straightened. A resection at the knee is sometimes of advantage to secure a straight limb instead of a useless contortion or a dangle leg; by using a high shoe or other appliance crutches may often be laid aside. In some of these cases electricity also does good. Though the first few applications to the paralyzed muscles may show no response, slight contractions not infrequently appear later, and voluntary control soon follows—weak, to be sure, but in proportion to the amount of muscular tissue undestroyed, and better by far than no motion whatever.

The local hypodermatic use of strychnia has had many advocates, not only in these late cases, but also in the early treatment. As any results to follow its use depend upon its stimulating action on the spinal centres and upon its general tonic value, the hypodermatic method is, in the case of timid children, the cause of useless pain and often of harmful mental excitement.

The arrangement of exercises to increase the strength of the involved muscles which retain some fraction of their muscular elements is of distinct advantage, and must be devised to meet the requirements of each case, but no elaborate apparatus is necessary. By passive and active movements and effort against resistance everything of this sort can be accomplished. Underlying systemic conditions like rickets, rheumatism, syphilis, tuberculosis, and bad hygenic surroundings of course require early and suitable attention. A fatty dietary, and particularly cod-liver oil, is often distinctly valuable.

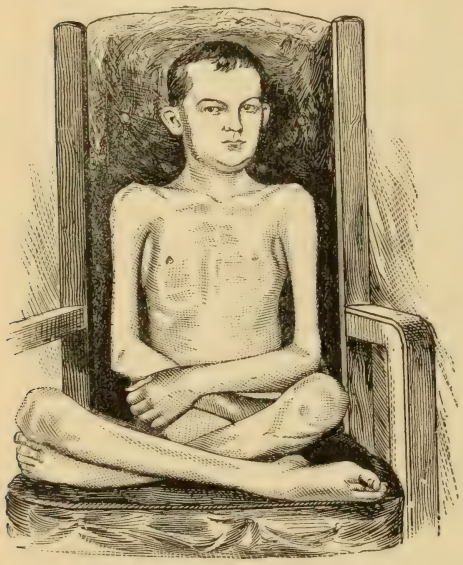
Subacute and Chronic Anterior Poliomyelitis.

Analogy to other febrile and inflammatory conditions would lead one to the expectation of encountering subacute and chronic forms of poliomyelitis, but

there are many who apparently doubt their entity or classify such instances under other headings. Though Gowers devotes several pages to these forms in the latest edition of his *Diseases of the Nervous System*, the impression conveyed is one of uncertainty as to their existence and discredit as to the cases reported under this caption. Other recent systematic treatises make no mention of the subject, except the description of the classic form of progressive muscular atrophy of the spinal variety. Cases, however, are encountered presenting every gradation between the sudden acute form and the pre-eminently chronic variety which produces our dime-museum "living skeletons."

In some instances there is a gradually developed weakness in one or more limbs, without or with an initial fever, and the palsy increases slowly for several weeks. After a stationary period of considerable duration it recedes, and only a trace is permanently left. In others the paralysis, insidious in its onset, goes progressively forward, involving limb after limb and producing conditions indistinguishable, as regards gross appearances, from those of progressive muscular atrophy.

FIG. 4.



Chronic Anterior Poliomyelitis.

Of the milder forms the following case is an example: A child of three, of healthy parentage and living in fairly good surroundings, active, bright, and lively in disposition, was noticed to have difficulty in getting up and down the stairs. Two weeks later she was unable to rise from the floor except by drawing herself up with the aid of her hands; she could not walk, and the lower extremities would quickly give way under her. The hands and arms then became slightly affected. A month later the symptoms commenced to recede, and, a year after, nothing was left but a little wasting of the anterior tibial muscles with slight quantitative electrical changes. There has been no absolute loss of faradic excitability at any time, no pain and no tenderness.

Of the chronic forms, the case figured in Fig. 4, from a photograph, is an instance: A boy of fourteen years, with no family or personal history of significance, at the age of six had an attack of "malarial fever" (?) lasting several weeks, and then could not use his legs or even stand. He gradually improved and after a year was quite active, when his muscular power again became impaired in the legs. Atrophy and weakness have steadily progressed to the trunk, neck, and upper extremities, with numerous contractures. He is able, however, to use a bicycle and get about on crutches. Many muscles fail to respond to all currents, some show only quantitative changes, and some comparatively recently affected show the reaction of degeneration.

Perhaps some cases of pseudo-hypertrophic paralysis should be classed in this place.

Diagnosis.—From neuritis the distinction is confessedly difficult, especially from that variety of neuritis which involves mainly the motor filaments, and

is not marked by the dysæsthesia and sensory difficulties, usually of importance and prominence in the history and differentiation of the peripheral disease. It is not unlikely that many reported cases of subacute poliomyelitis have been mistaken in this way.

Treatment is practically futile in the progressive form, but those measures which commend themselves in chronic myelitis should be faithfully tried, and local measures, such as vigorous massage and electricity, have produced temporary improvement. In the subacute variety these measures seem to be distinctly productive of good, and what has been said of the prevention of contractures and deformity in the acute form of cornual disease may be reiterated.

LANDRY'S PARALYSIS.

By ARCHIBALD CHURCH, M. D.,

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The obscure paralysis known, since Landry's description of it in 1859, by his name, and designated "acute ascending paralysis" by English writers, while presenting a striking clinical entity in typical cases, shades off materially from early descriptions in many instances more lately observed. It may be roughly described as an acute disease marked by paralysis commencing in the lower extremities, usually in the feet, which progresses steadily upward, involving the trunk, upper extremities, the neck, until finally deglutition, respiration, and the heart are implicated. There is slight or no modification of sensation; the muscles do not rapidly waste nor usually lose their electrical excitability and myotatic response; the sphincters are exempt; bed-sores do not occur; and the temperature is frequently normal throughout the attack. In cases that recover the parts last and least affected soonest regain power, and improvement, therefore, extends from above downward. Fatal cases terminate by respiratory or cardiac failure in from one to two weeks.

Etiology.—The causation of Landry's paralysis is practically unknown. It occurs in men more frequently than in women, and most frequently between the ages of twenty and forty. In children it has been recognized very rarely. It is known to follow infectious diseases which are provocative of neuritis. Exposure to cold, and very rarely trauma, alcoholism, and syphilis, have preceded it.

Pathology.—In some well-marked cases the most thorough examination of the cerebro-spinal apparatus by competent pathologists has failed to discover the slightest abnormality. Several cases have presented a diffuse myelitis: one or two, a cross-myelitis; a few, well-marked neuritis, and some have shown changes both in the spinal cord and in the peripheral nerves. No constant lesion is present. In some instances there has been pronounced swelling of the spleen, pancreas, and mesenteric glands.

The frequent lack of anatomical findings, the onset and course of the disease, its relations to antecedent infectious maladies, such as typhoid, small-pox, influenza, etc., and its close resemblance to multiple peripheral neuritis, with which, indeed, a large number of observers consider it identical, lead to the almost positive conviction that it is the result of some infection or toxine. Bacteriological investigation has thus far been inconclusive, though highly suggestive.

Symptoms.—Generally without malaise, fever, or premonitory symptoms, usually without tingling, numbness, or other sensory disturbance, a feeling of weakness begins in the feet and legs, and slowly creeps upward, becoming more and more pronounced in the lower levels as the disease mounts. At the end of two or three days or a week the lower extremities are completely paralyzed and the weakness has involved the trunk and upper limbs. The breathing becomes

superficial from involvement of the diaphragm, and difficulty of swallowing soon appears. In severe cases every voluntary muscle below the face is completely paralyzed and relaxed. Cerebral and mental symptoms are absent until the dyspnœa or cardiac failure is pronounced and induces them. The sphincters are, as a rule, not relaxed; there is no tendency to bed-sores or dystrophy; the tendon and superficial reflexes are usually present; the electrical responses are normal; and sensation, together with the special senses, is not perverted. If a fatal issue do not occur, the symptoms of paralysis slowly recede in the reverse order of their appearance, and when they have distinctly subsided from the upper levels recovery may be anticipated.

In some cases the onset is reversed, the upper extremities first showing weakness; and, indeed, the ordinary type may be infinitely modified, as can be readily understood from the varying anatomical distribution of the organic lesions in well-authenticated observations. In one case falling under the writer's attention, where the clinical history was typical, complete wasting of isolated muscle-groups in all four extremities occurred, and was persisting four years later, without any appearance of ultimate improvement. Paræsthesia and dysæsthesia are not rare. Loss of reflexes has been noted. The progress of the paralysis may stop at any point, and then recede. A temperature of 101° to 103° F. has been rarely observed, but as a rule it does not rise above the normal.

Course.—The course from inception to fatal termination may be very brief, less than two days, and fatal cases usually end within ten days. Prolonged cases may only reach their acme in a month. After a stationary period of varying length in the hopeful cases, improvement takes place usually in a retreating order, but convalescence is slow and may require months. On the other hand, it may be rapid, or, as in the case mentioned above, permanent injury may result.

Diagnosis.—The diagnosis in some cases must necessarily be extremely difficult, but in the typical form is readily made, providing the existence of this rare disease is kept in mind. It rests upon the method of invasion, the pure motor paralysis, the negative conditions as to reflexes, sensation, and electrical reactions, and the history of some possible toxæmic state. Some cases are complicated by hysteria, which is capable of greatly obscuring the diagnosis. When slight electrical changes and paræsthesia are present, it is impossible to exclude neuritis, and the integral character of the peripheral disease in some instances has already been pointed out. In general myelitis we have all spinal cord-functions involved. In meningitis the pain and rigidity are distinctive.

Prognosis should always be grave, since even in the irregular and prolonged cases one cannot foretell at what moment bulbar symptoms may appear, and the main danger to life depends on their presence. Rapidly-ascending symptoms imply a speedy termination, but there is no invariable rule. Only when the tide has turned and symptoms are receding can one entertain a reasonably hopeful prognosis. The presence of neuritic conditions or of electrical changes implies a prolonged convalescence and some doubt as to ultimate recovery. Where cerebral symptoms appear, they are of bad import, signifying either profound toxic conditions or the near approach of death from cardiac and respiratory failure.

Treatment will be directed against any general toxic condition present or reasonably suspected. The salicylates, tincture of the chloride of iron in full doses, bichloride of mercury to the point of toleration, thorough cleansing and disinfection of the alimentary tract, supportive diet, conservation of nervous energy and strength, are valuable. To the spine a narrow sinapism the whole

length of the back, frequently repeated, is of service; even the thermo-cautery is advised by some. Full and frequent doses of ergot or ergotine have strong advocates. The paralyzed limbs should be gently massaged to improve circulation and give comfort. When swallowing becomes difficult or impossible, feeding by the stomach, nasal, or rectal tube must be adopted, and the preference is for the nasal tube, providing care be exercised to avoid passing it into the larynx. During convalescence massage, electricity, local douches, tonics, generous diet, and general measures are the main reliance.

TUMORS OF THE SPINAL CORD.

By JAMES HENDRIE LLOYD, A. M., M. D.,

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Under the head of Tumors of the Spinal Cord will be considered tumors not only of the cord itself, but also of its enveloping membranes. The latter are the most common. Tumors originating in the bones of the spine, if they make pressure upon the cord, are very similar clinically to tumors of the membranes, but they are exceedingly rare.[1]

Tumors of the spinal cord and its membranes are comparatively rare at all ages, but they are not unknown among children. Thus in a table of 50 cases of cord-tumors analyzed by Dr. Mills and the author, 14 per cent. were in patients under twenty years of age. Four were in the first decade of life, and three in the second.

Etiology.—The causation of tumors of the spinal cord is usually very obscure, just as it is for tumors of other parts of the body. The nature of these growths, as will be seen, varies, and the causes that produce them vary as well. Syphilitic and tuberculous tumors are of course caused by their respective infections in the blood and tissues. Carcinomata and sarcomata have here, as elsewhere, a totally unknown essential cause. Gliomata and myxomata are equally obscure in origin. The gliomata originate always in the neuroglia, and are probably the product of a proliferation of germinal tissue which has remained in an embryonal state. They are most apt to occur in the central gray matter and in the posterior gray commissure in the neighborhood of the central canal. In this region they break down and form cavities to which the term "syringomyelia" is applied. As this process is now recognized as a distinct disease, it has been described apart. Other cysts, simulating tumors, may be caused by small hæmorrhages, and possibly by emboli. Parasitic growths, such as echinococcus, have been found in the spinal cord.

As a direct exciting cause trauma has been regarded by many as not infrequent. Where there is predisposition to a cancerous growth or a syphilitic deposit it is possible that trauma may so act. Exposure to cold, sexual excess, and overwork have probably nothing to do with the origin of tumors of the cord.

These growths are apparently about equally divided between the sexes. In the table already referred to it is seen that 22 cases occurred in males, 21 in females, and in the remaining 7 the sex is not recorded.

Symptoms.—The symptoms of tumors of the spinal cord may be conveniently classified according as they are sensory, motor, trophic, visceral, and intracranial. They may then be grouped according to the level of the cord at

[1] Mr. Wright of Manchester removed a fibro-sarcoma of the neck which had invaded the spinal canal by way of one of the intervertebral foramina, causing pressure symptoms. (Reported by Thorburn, *Surgery of Spinal Cord*, p. 168.)

which the tumor occurs. This twofold plan will be adopted here for the sake of both clearness and brevity. Finally, a comparative study of symptoms will be made under a separate head for the purposes of diagnosis.

It is doubtful if a distinction can always be made in diagnosis between the meningeal and medullary growths. In some cases, however, this may be possible. The tumors springing from the membranes are more likely to cause pain as an initial and persistent symptom than are tumors within the substance of the cord. They cause pressure symptoms later. It is probable, too, that the early symptoms caused by them are more distinctly local, because they press upon and irritate or destroy a comparatively small area of the cord at first.

The sensory symptoms of all tumors of the cord and its membranes are sooner or later conspicuous. Pain, as has just been said, is common. This pain may be limited in the early stages to one or few nerve-trunks, in one of the limbs or in the abdomen, for instance, simulating neuralgia, or it may radiate from the spine in association with stiffness of the muscles of the neck or back. It is often an urgent and distressing symptom. Hyperæsthesia, which is closely allied to pain, may appear in the course of the disease. In cases in which the lesion is unilateral this hyperæsthesia may exist in the paralyzed side: in other cases its distribution is variable and its duration uncertain. Hyperæsthesia, and especially pain, may exist along the spinal vertebræ, and localized pain may sometimes be elicited by tapping vigorously on the spine at and near the seat of the tumor. Paræsthesia, or perverted sensibility—as, for instance, burning and pricking sensations and formication—is closely allied to hyperæsthesia, and may appear like it, especially in the early and middle stages.

Anæsthesia is a very common symptom of these tumors, yet the time of its appearance, as well as its distribution, varies greatly according to the site and progress of the neoplasm. As with pain, its early distribution may be quite limited; for instance, it may be confined to the area of distribution of one or few nerve-trunks or to one limb. This limitation of the early symptoms, whether motor or sensory, is a characteristic of these growths. The anæsthesia may be associated with pain in the affected area—the *anæsthesia dolorosa*. In the later stages of the disease the anæsthesia is more widely extended, and may be profound. Thus it is often complete in the trunk and limbs below the seat of the tumor. Thermo-anæsthesia may be observed in some forms of cord-tumors: perhaps it would have been oftener reported if it had been oftener looked for. In the central gliomata, especially when they form cavities, as in syringomyelia, anæsthesia to heat and cold is a common symptom; it is then associated with analgesia, while tactile sensation is preserved, thus forming a "dissociation" symptom which is quite characteristic. This thermo-anæsthesia is probably not a common symptom of meningeal growths; in fact, it is doubtful if it ever appears as a result of them, especially in this dissociation. Analgesia, or loss of pain-sense, may be seen in some cases of tumor of the cord. It may be associated, as above noted, with loss of temperature-sense, or it may exist alone. It is always an accompaniment of profound anæsthesia.

A not uncommon symptom is the girdle-sense. This consists of a feeling of constriction, as of a cord tied around the part. Its location varies with the seat of the tumor. Thus it may be felt around the neck, chest, waist, or abdomen, and a rare case is reported in which it was felt even in the legs.

The motor, like the sensory, symptoms of tumors of the spinal cord vary in kind and extent according to the seat and stage of growth of the lesion.

Like them, too, they are apt to be very limited when they first appear, and to gradually extend. This mode of appearance and extension is very characteristic of a neoplasm at some point in the spinal canal. The earliest motor symptom may be a paresis or a cramp of the muscle, or these may alternate or exist at the same time. Paresis may be limited at first to a muscle-group, whence it may gradually extend to involve a limb or the limbs of one side or both lower limbs. Before, however, it has spread thus far, it will most probably have deepened into a paralysis. When this paresis has well advanced, contractures in the affected muscles appear. These contractures distort the limbs, and often become so firmly set that they can be overcome only with great difficulty, and perhaps only with great pain to the patient. The tone of the muscle and the state of its reflex activity to a tap on its tendon vary according to whether its centre in the cord is involved in, or is below the seat of, the tumor. In the former case the muscle is flaccid and its reflex lost, while in the latter case, the centre in the cord being cut off from the inhibitory centre in the brain-cortex, the myotonus and the tendon reflex are much exaggerated.

Muscular atrophy may be caused by tumors of the spinal cord, according to the well-known pathological law that a muscle wastes when its trophic centre in the cord is destroyed. Hence in cases of these tumors the atrophy usually occurs in limited muscle-groups, or in one limb, or possibly in both arms if the cervical enlargement is affected, or in both legs if the tumor is in the lumbar enlargement or cauda equina. Hence a not uncommon type of motor disorder is seen in cases of tumor of the cervical region; in which cases, the trophic centres in the anterior horns being destroyed, a muscular atrophy in the arms results, while, the descending motor paths in the lateral columns being injured, a spastic paresis, without atrophy, but with increased knee-jerks and with ankle-clonus, is seen in the legs. When the process in the cord is rapidly destructive, the atrophied muscles present very soon, as a rule, changes in their electrical reactions. During the very early stage, or stage of irritation, the electrotonus may be increased to both currents, but sooner or later this is diminished, while modal changes occur; and in very rapid or advanced cases, in which the anterior horn has been quickly destroyed, the true reactions of degeneration may occur. In slowly progressive cases, in which the horn is destroyed very gradually, the qualitative changes may not appear in a typical manner.

Spasms, twitching, and contractures of the affected muscles are frequently seen. Cramps in the back and limbs are sometimes complained of. Contractures, as already said, are usually secondary to advancing paresis. Fibrillary contractions, so common in progressive muscular atrophy, are rarely seen: in the table of fifty cases referred to they are mentioned only once. Epileptic convulsions do not occur. In the only case to which the author has a reference the fit must have had some origin not recognized. Tetanoid cramps and spasms, opisthotonos, torticollis, and scoliosis are all symptoms which may arise in the course of tumors of the spinal cord.

Ataxia is not a common symptom of these tumors. This may be because tumors occupying the exact region of the lesion of locomotor ataxia—*i. e.* the posterior columns, horns, and root-zones—must be exceedingly rare.

Various trophic lesions may occur. These lesions are identical with those caused by other affections of the spinal cord producing transverse or extensive destruction. The most important are bed-sores. These bed-sores may be attended in time with septic infection of the blood, and thus cut short the patient's life. Other trophic lesions are œdema, glossy skin, maculæ, and

bronzing of the skin, and perhaps in some cases more destructive lesions. Vaso-motor involvement has been noted by some observers. Flushing of the skin and excessive sweating are among these phenomena. Alterations in temperature in the paralyzed parts occur. The most common permanent alteration, especially when paraplegia is complete, is a slightly subnormal temperature. Early in the case the more paralyzed parts may present an increase in temperature.

The visceral symptoms of tumors of the spinal cord depend to some extent upon the location of the growth. The most common is paralysis of the bladder. It is the most common because the centre for the bladder is low in the cord, and consequently is cut off from volitional control by tumors at almost all levels. When the tumor is in the lumbar enlargement the centre for the bladder may be destroyed, causing complete paralysis, both direct and reflex, of the viscus. When the tumor is above this level, however, the reflex irritability of the bladder may be retained for a while. In the former case retention is much the more common; in the latter, incontinence. Later, in all cases, retention, with overflow, is apt to be the rule. Paralysis of the sphincter ani is caused in exactly the same way as that of the bladder.

In lesions in the cervical region embarrassed breathing and rapidity of the heart's action may occur. Choking sensations are sometimes experienced. Vomiting is not a common symptom.

Intracranial symptoms are, from the very nature and seat of the growth, not common in tumors of the spinal cord, but they are not unobserved. Vertigo has been recorded in one case in which the tumor was high in the cervical cord. Changes in the optic disk have also been seen in similar cases. Headache is noted in only three instances in the table of fifty cases already referred to. Alteration in the pupil might be caused by paralysis or irritation of the sympathetic centre in the cervical cord. Mental symptoms are not caused by tumors in the spinal canal except as secondary phenomena due to pain, weakness, and abandonment of hope.

Among other secondary symptoms are cystitis and pyelo-nephritis. Priapism has been reported in a few cases.

Tumors of the spinal cord present several clinical types according to the area and the level occupied by the new growth. In some cases in the early stages one lateral half of the cord is first and most involved. Such a case presents the type first described by Brown-Séquard.[1] There are paralysis and loss of muscular sense, with hyperæsthesia, on the side of the lesion, and anæsthesia, and possibly analgesia, on the opposite side. This distribution depends on the fact that some of the sensory fibres decussate at or about the level of their entrance into the cord. A notable absence of sensory symptoms occurred in a patient of the author's. A carious spot in one of the cervical vertebræ caused hemiplegia without any sensory involvement whatever. The case exactly resembled hemiplegia of cerebral origin. An operation was performed by Dr. Deaver.

Other types depend upon the level of the cord at which the tumor occurs. The favorite sites for these tumors are the cervical and lower dorsal regions. Of the 50 cases in Mills and Lloyd's table, 22, or almost one-half, were included entirely or in part in the cervical cord; 4 were in the upper dorsal region; 12

[1] The author gives a place in the text to a description of this type, although he knows that recent experiment throws much doubt upon the accuracy of the claim to any such clinical findings. Thus Gotch ("Recent Research on the Spinal Cord," *Liverpool Med.-Chir. Journ.*, Jan., 1893) says: "Recent physiological research shows that, in opposition to the views formerly advocated by many neurologists, the path for sensory conduction is almost entirely on the same side as that of the entering sensory nerves."

in the lower dorsal; and of the remainder, 4 were in the lumbo-sacral region, 3 in the filum terminale and cauda equina, and the rest were of doubtful location or nature.

The type presented by a cervical tumor is often quite characteristic. Pain is located in the neck, arms, and upper part of the back. Torticollis or retraction of the head may occur. Anæsthesia is variously distributed according to the region most involved. The anterior cornua, entire or in part, on one or both sides, may be destroyed, and consequent atrophy of muscles in the arm or arms, with altered electrotonus, may be observed. Paraplegia, beginning perhaps as crural monoplegia, is sure sooner or later to appear; and this is of the spastic type, with increased knee-jerks and ankle-clonus, but without muscular atrophy in the leg muscles. Complete anæsthesia in the trunk and legs supervenes; paralysis of the bladder and bed-sores complete the picture.

Tumors in the dorsal region present the type of a simple transverse lesion slowly advancing to paraplegia and anæsthesia, with bed-sores, incontinence, and cystitis, but without involvement of the neck and arms. The signs of irritation, such as neuralgic pains, girdle-sense, and zone of hyperæsthesia at the level of the growth, are sometimes very characteristic. Dyspnœa, due to partial paralysis of respiration, may be caused by tumors in the cervical and upper dorsal region.

Tumors in the lumbar region and in the cauda equina give a still different type, depending upon the fact that the trophic cells in the anterior horns, the anterior nerve-roots, and the nerve-trunks are implicated. Hence, in addition to paraplegic symptoms and neuralgic pains about the lower part of the trunk and in the legs, there may be muscular atrophy, reactions of degeneration, and abolished tendon-reflexes in the legs, and possibly an irregular distribution of anæsthesia in areas supplied by nerve-trunks in the cauda equina most involved. Moreover, the reflex centre for the bladder in the lumbar cord being destroyed, obstinate retention, with overflow, may occur. In tumors limited entirely to the cauda equina the symptoms are simply those of neuritis—*i. e.* neuralgic pain, often intense, anæsthesia, muscular atrophy with reactions of degeneration, abolished reflexes, and paralysis. The distribution of these symptoms will depend entirely upon the distribution of the nerves implicated. This distribution may be very irregular, and by this irregularity constitute a distinct type. Paralysis of the bladder may occur in these cases.

Morbid Anatomy.—According to the table already referred to, the most common forms of tumor of the spinal cord are the sarcomata and the structures allied to them. Thus, of 50 cases, 12 are described as sarcomata and gliomata: 9 are distributed in the list among myxomata, psammomata, and fibromata, of which number it is fair to assume that some at least were structurally similar to the sarcomatous type; while of the 2 described vaguely as "cancer," and of the 6 unclassified, a proportion would probably have been found to be sarcoma or glioma on more exact observation. Carcinoma occurred but once, parasitic growths three times. Syphilitic growths were found in 5 cases, massive tubercle in 4.

Dr. Herter, in a contribution to the pathology of solitary tubercle of the spinal cord, has analyzed 26 cases. His study shows that the affection is a disease of adolescent and early adult life, 20 of these cases occurring before the age of thirty-five. In all but one the massive tubercle was solitary. In most of the cases tubercular disease existed in other parts of the body and antedated the cord lesion. Hayem, however, quoted by Herter, reported a case which he regarded as primary.

Secondary lesions are usually found in cases of tumors of the spinal cord. Meningitis and œdema of the membranes, also inflammatory exudate, are occasionally noted. The cord is usually compressed, its substance softened both above and below the tumor. Secondary degeneration occurs in the system-fibres of the cord. Hæmorrhages have been observed. Cysts may be formed, or the central canal may be dilated (hydromyelia). Gummata and carcinomata have caused erosion of the vertebræ.

Diagnosis.—Tumors of the spinal cord may be confused with hæmorrhage, pachymeningitis, transverse myelitis, spinal caries, fractures of the vertebræ, neuritis, and hysteria.

Hæmorrhage into the spinal canal or spinal cord, unless the result of violence, is extremely rare. When it happens from diseased blood-vessels it is very sudden, and the symptoms attain almost at once their maximum of intensity. Compression and destruction of tissue may be sufficient to cause paraplegia in a few hours. It is possible that some of the early symptoms, due to compression, might abate in time, and that the permanent results would be focal with secondary degenerations. The usual result, however, is death.

Pachymeningitis, especially in the cervical region, is very difficult to distinguish from a tumor. It causes, perhaps, on an average, more acute pain and stiffness in the neck than does tumor, and it is more widely distributed in vertical extent.

Transverse myelitis also closely simulates tumor. In some of these cases the lesion is very limited in vertical extent. The onset of myelitis, however, is not usually so gradual as that of tumor, and this is probably the best distinguishing point. Another distinction is the degree of pain. In myelitis pain is sometimes not very severe. Cases are seen in which the girdle-sense and a zone of hyperæsthesia are the nearest approach to it. The writer has seen also white softening of the cord, very limited and entirely transverse, cause symptoms very similar to transverse myelitis, the absence of pain being very conspicuous.

Spinal caries in its early stages may resemble a tumor, but the cases must be very rare in which a deformity of bone cannot be detected comparatively soon. As a rule, pressure-symptoms do not appear until long after the deformity is apparent.

Fractures of the spinal vertebræ are indicated by the history, even though deformity is not very apparent, as is sometimes the case. It is not probable that confusion could often arise between this, or any other form of trauma in which the history were known, and tumor.

Neuritis might simulate a neoplasm in some cases; in fact, neuritis is one of the symptoms of tumor of the spinal cord. When it is caused, however, by a tumor within the spinal canal, it is not likely to be the only symptom; thus evidence of compression is soon made manifest. Multiple neuritis is not apt to be confined to the arms: in a case in which it were, compression symptoms in the legs would be wanting. If confined to the legs, it would not cause paraplegia with involvement of the bladder, etc. But such a distribution of multiple neuritis is rare. It is usually apparent in both arms and legs, in which case confusion with tumor is hardly possible.

It is customary to say that hysteria simulates all diseases, but this statement is based upon superficial observation. Blocq is nearer the truth when he says that hysteria does not simulate any disease perfectly—that there is always something wanting. To detect this missing element is often the rather easy forte of the expert. No rule can be given in brief space. It may be said, however, that the symptoms most dependent upon organic change are most apt

to be wanting in cases simulating tumor or other organic disease of the cord; excessive knee-jerks, very free ankle-clonus, muscular atrophy, and the reactions of degeneration are not usually seen. In fact, the latter two symptoms are never seen. But more important even than to detect the negative evidence is to observe the positive symptoms of hysteria itself. These are the so-called stigmata, which in probably all cases simulating grave organic disease can be detected. Among these stigmata are hemianæsthesia, including the special senses, concentric narrowing of the visual fields with alteration of the color fields, segmental anæsthesia in paralyzed limbs, tremor, and convulsive phenomena. Transfer and suspension of symptoms by suggestion (hypnotism) may be obtained. The mental stigmata, emotional, lethargic, etc., are often characteristic.

Prognosis.—The prognosis of tumors of the spinal cord is not quite so bad as formerly, because, in some cases at least, surgery may come to their relief. The success of surgery will depend primarily, of course, upon the successful localization of the growth and upon its situation at an accessible part of the spinal canal. Even then some permanent damage may have been done by the neoplasm before its removal. The prognosis, if dependent upon treatment by drugs, is uniformly bad. No exception to this rule can be made in favor of a syphilitic tumor, because syphilitic lesions large enough to be called tumors are not, in the author's experience, removable by such means.

The duration of these cases varies. Some cases are rapidly fatal, lasting only a few months; others are reported as lasting for more than three years.

Treatment.—As has just been said, treatment by drugs offers no hope in any case of tumor of the spinal cord. While we believe that the syphilomata are no exception to this rule, we should, nevertheless, give the patient very active antisyphilitic treatment if he had a clear history of syphilis. We should do this in the hope that the lesion were not truly a tumor, but rather a more diffused process, such as pachymeningitis, and that it had not yet irreparably damaged essential portions of the cord. When the syphilitic neoplasm has become sufficiently massive to be worthy of the name of tumor, it has usually produced, and will continue to produce, such destruction of the nerve-elements that repair on the one hand, and arrest on the other, cannot be obtained by drugs. The writer says this from personal experience, not exactly with syphilitic tumors of the cord, but with their congeners, meningeal gummata within the skull. In several cases, in which progressive erosion of the bone occurred, no perceptible influence was exerted by the so-called specifics.

Surgery offers the only rational treatment of these cases, but this remedy must be used with rare caution after the most painstaking diagnosis, and with the clear understanding that success may not be obtained. The following points, according to Thorburn, must be considered in all spinal lesions: First, the curability without operation; second, the dangers of the operation; third, disastrous results, such as weakening of the vertebral column; fourth, the selection of appropriate cases. In the case of a spinal tumor it may be said, in reference to these four points, that, first, the case is not curable without operation; second, that the dangers of the operation are not so great as the risk of going without it; third, that the spine would not be weakened seriously, except in the very rare event of extensive erosion; and, finally, that the selection of appropriate cases depends entirely upon the successful diagnosis and localization of the tumor at as early a stage of its growth as possible. Hence, the operation is not only advisable, but, it would seem, in properly selected cases, imperative. Tumors of the spinal cord have been successfully localized and

removed. Such an operation was performed by Mr. Horsley on a man with myxofibroma in the upper dorsal cord. The symptoms were complete paraplegia, motor and sensory, of slow development, accompanied with attacks of agonizing pain. Although degeneration of the lateral pyramidal tracts had existed, as shown by intense spastic paraplegia, every indication of this is reported by Dr. Gowers to have since passed away.

In cases in which, for any reason, surgery is declined or ignored, and exclusive reliance is placed upon other treatment, the most important, and, in fact, only useful, means to give comfort to the patient are the water-bed and opium. Antiseptic treatment of bed-sores is important.

SYRINGOMYELIA.

By JAMES HENDRIE LLOYD, A. M., M. D.,

Philadelphia.

Syringomyelia is a disease of the spinal cord, characterized by the growth of a gliomatous tissue, which breaks down and forms a cavity, usually in the mid-region of the gray matter.

Syringomyelia has been recognized within only a comparatively recent period. The word was coined by Ollivier in 1837, and applied by him to all canals or cavities in the cord. Every such canal or cavity was considered pathological until Stilling demonstrated the normal central canal. Virchow and Leyden used the word "hydromyelia" to designate cavities in the cord, which they claimed were always dilatations of the normal central canal. Simon, in 1875, pointed out the pathological process which interests us here. He demonstrated that cavities, quite apart from the central canal, may occur in the cord in the midst of a newly-formed gliomatous tissue by the breaking down of which they are caused. He proposed to reserve the term "syringomyelia" for this special form of cavity; and this specialization is now accepted by most writers. Syringomyelia therefore has come to be regarded as the product of a gliomatosis. The word "hydromyelia," on the other hand, may be restricted to the dilatation of the central canal, which happens occasionally as a secondary phenomenon in various cord lesions, and which is different, both anatomically and clinically, from true syringomyelia.

Of late years a quite voluminous literature of syringomyelia has grown up. Among monographs we may note especially that of Bruhl, which brings the subject quite up to 1890. Since that time some reports of cases, proving the accuracy of the symptomatology of the disease, as verified by the post-mortem findings, have appeared.[1] Doubt lingered in the minds of many for a long time whether syringomyelia could justly be regarded as a disease-entity, but these accumulating observations in very recent years must effectually silence all criticism.

Etiology.—Syringomyelia is much more common in males than in females. Bruhl found the proportion as 28 to 8. Roth is reported as saying that the disease is three times more common in males than in females.

The disease appears usually at a comparatively early age. Charcot, quoted by Bruhl, says that the first manifestations appear between the fifteenth and twenty-fifth years. In some cases the time of the début of the disease is uncertain. The author's case was in a male, and appeared first about the twenty-seventh year.

From the above facts it is seen that syringomyelia, while not exactly a disease of childhood, is usually a disease of adolescence or early adult life. It

[1] See report of a case by the author, with photographs of sections of the spinal cord, *Univ. Med. Mag.*, Philada., March, 1893.

probably has close affiliations with at least one well-recognized disease of childhood—viz. hereditary ataxia or Friedreich's disease.

Traumatism and exposure to cold seem to have been exciting causes in some cases. The infectious diseases also have appeared to be the starting-point.

Syphilis and alcohol do not seem to be causes of this disease.

According to Bruhl, syringomyelia is a disease probably of evolution, a congenital affection having its origin in an anomaly of development of the ependyma. We shall refer to this subject again.

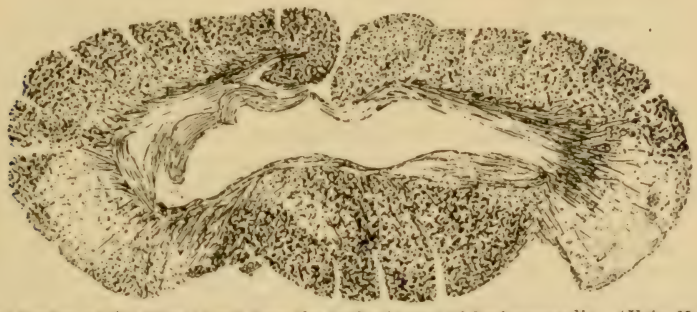
Pathology.—Cavities in the cord, as already said, are the results probably of several pathological processes. Thus they may be formed by the dilatation of the central canal, this dilatation being an accompaniment of some other morbid state, such as inflammation, hæmorrhage, or neoplasm. They result sometimes perhaps from small hæmorrhages into the substance of the cord. Some recent authors, notably Hoffmann, still classify all these varieties, and make, as it were, one general group of them. We believe this is wrong. Most of such cavities are merely accidents or terminal products left by various pathological processes. The true syringomyelia is, in our opinion, a process *sui generis*, and is in no way identical with the other members of the rare and heterogeneous groups alluded to. We accept the theory, adopted now by Schultze, Bernhardt, Simon, Westphal, Charcot, Dejerine, and others, that syringomyelia is the product of a true gliomatosis, which occurs usually in that region of the cord that is developmentally the weakest—*i. e.* the region of the posterior gray commissure and posterior median septum. This proliferation of neuroglia tissue leads to the formation of a cavity by the gradual softening and absorption of the new growth. Its usual site in the gray commissure and posterior septum suggests that it may result from an anomaly in the development of that region of the cord last formed by the folding over of the medullary folds in the embryo. According to this theory, the central canal is not necessarily the starting-point of the process, although it may be involved ultimately in it. In the author's case this profuse overgrowth of neuroglia tissue was a conspicuous feature, while the central canal, as marked by a mass of epithelial cells, was entirely distinct from the cavity. In another case, however, published recently by Dr. James Taylor, the cavity was lined in some places with epithelial cells, proving conclusively that the central canal had become included in the syringomyelia.

Morbid Anatomy.—The cavity is usually largest in the cervical region, whence it extends downward to various levels in different cases. In some cases it trends to one side. It may extend as far as, or even into, the lumbar enlargement, but this is not the rule. In many cases the lumbar enlargement, with exceptions yet to be noted, is normal. At its seat of greatest extent the cord may be literally a hollow tube. In the fresh state the cord is flat or ribbon-like, and gives to the finger a sense of fluctuation.[1] There is usually not much, if any, evidence of inflammation. The integral parts of the cord are much distorted and even injured by the syringomyelia. The cavity (see Fig. 1) occupies the central gray matter or commissure, the anterior, or white commissure, usually escaping. The normal central canal may exist apart, in which case it is apt to be disfigured, and perhaps only recognizable by its epithelial cells, or it may be included in the cavity, in which case the latter is lined at places with columnar epithelial cells. The cavity is often widely extended laterally, and may run down the posterior horns or even the posterior median septum. It pushes before it the gray matter, which is seen in the author's case to be stretched around the ends of it. The anterior horns are distorted, and

[1] In two cases observed post-mortem by the writer, this macroscopic appearance was very striking.

the multipolar cells in them are in many instances atrophied. The posterior horns, the posterior root-zones, and the posterior columns are especially liable to injury. The horns and root-zones may be distinguished only with difficulty, and the posterior columns present various stages of degeneration. The lateral

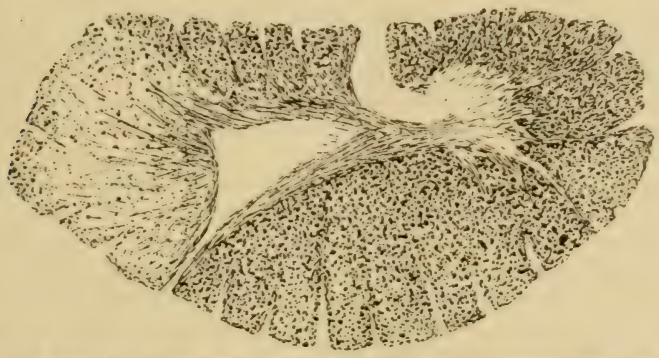
FIG. 1.



Cervical Region of the Spinal Cord from the author's case of Syringomyelia. (*Univ. Med. Mag.*)

pyramidal tracts are often very much degenerated, as are, also, the direct pyramidal tracts. The cavity itself is usually surrounded by a newly-formed tissue. This is seen, under the microscope, to be a densely felted tissue, with fibrils making innumerable meshes. It is rich in neurogliar nuclei. Some writers point out a lining membrane to the cavity, composed apparently of a comparatively more densely felted layer of gliomatous material. Blood-vessels are scattered but sparsely through this tissue. Above and below the region of

FIG. 2.



Upper Dorsal Region of the Spinal Cord from the author's case of Syringomyelia. (*Univ. Med. Mag.*)

greatest extent of cavity the morbid anatomy varies. System-lesions may extend in either direction according to their nature. The medulla oblongata is variously affected. It may be the seat of nuclear degenerations identical with those of bulbar palsy. In the author's case one pyramidal tract was degenerated through the decussation, and the ascending cerebellar tract on one side, as well as the funiculi gracilis and cuniati on each side, was deeply sclerosed. Below the cavity the lateral pyramidal tracts are often degenerated to their extreme limits in the lumbar enlargement. The lumbar enlargement, even when it apparently escapes invasion, may exhibit, on close microscopical search, the presence of gliomatosis in a small area in the gray commissure. The anterior horns in the lumbar cord, unless the cavity extends thus far, are not affected.

Symptoms.—The symptoms of syringomyelia may be divided into two classes, according as they are dependent upon lesions, first, of the gray matter of the cord, and second, of the white matter. The first class includes the essential symptoms; the second, those that are secondary to them. These essential symptoms may be subdivided into three groups, according to the region of the gray matter affected.

The first probably of these essential symptoms to appear is a characteristic disorder of sensation. This presents a type. It is an analgesia, or loss of pain-sense, combined with thermo-anæsthesia, or loss of power of distinguishing heat and cold, without true tactile anæsthesia and loss of muscular sense. This peculiar type has been called by Charcot the *dissociation* symptom of syringomyelia. It is more typical of the disease than any other one symptom-group, and is truly typical of no other affection, although occasionally seen in hysteria.

These sensory changes usually show a segmental distribution. They are sometimes hemiplegic in type, sometimes monoplegic, but usually distributed only to segments of the limbs or trunk. Exceptions and variations occur. Thus in the author's case zones of anæsthesia were found on the shoulders and about the waist. Occasionally areas of hyperæsthesia exist; thus, in this same case, while one side presented quite typically the "dissociation" symptom, the other was the seat of hyperæsthesia. The zone of anæsthesia to heat and that to cold do not always exactly correspond. The analgesia of syringomyelia is often very profound, so that the patients may be quite insensible to most destructive trophic or traumatic lesions, to which reference will be made later. The exact affected region of the cord that gives rise to the sensory symptoms is probably the posterior gray commissure and parts of the posterior horns.

The essential motor-symptoms of syringomyelia depend upon a progressive atrophy of the cells of the anterior horns of the gray matter. As the cervical enlargement is invaded much more commonly than the lumbar, it follows that the arms rather than the legs are the parts involved in the consequent muscular atrophy. This progressive muscular atrophy is usually of the atonic variety—*i. e.* the muscles are not spastic and do not show exaggerated myotonic and tendon reflexes. This is the type called Aran-Duchenne. There are exceptions to this rule, however, as in the author's case, in which the tonic or spastic type, with exaggerated reflexes, was present. The affected muscles exhibit fibrillary movements. Reactions of degeneration are not seen in these muscles, although in advanced cases quantitative changes occur, and in extreme cases very little if any response can be elicited by either current. This wasting often begins in the hand—for instance, in the thenar and hypothenar eminences. It may be the first symptom to attract the patient's attention. Loss of power is proportionate to the atrophy. One hand may be affected before the other. The wasting in the muscles of the shoulders and arms may become extreme. The biceps, deltoid, infra- and supra-spinati and lower part of the trapezius may be almost entirely lost. The forearm and deeper neck-muscles also may be much affected. The weakness of the neck-muscles may become so extreme that the head falls forward on the chest, and even requires an assistant to support it when the patient sits upright. Tremor has been observed not unfrequently, especially in the hands and fingers.

The third group of essential symptoms is a somewhat arbitrary one. It is composed of those symptoms that are claimed by some writers to depend upon the invasion of the mid-region of the central gray matter. Bruhl includes in this group trophic lesions, scoliosis, vaso-motor disturbances, weakness of the sphincters, oculo-motor disorders, and involvement of the bulb. Without

criticising this grouping we may accept it for convenience in clinical description. Whatever their exact origin, it is certain that some at least of these symptoms are common in this disease.

The trophic lesions occur in the skin and in the bones and joints. The skin may show hypertrophies, callosities, ulcerations, various eruptions and maculæ, or may be glossy in places. The nails of the fingers and toes are sometimes involved. They become thickened, have transverse ridges, and may even fall off. Panaris, or whitlow, is an obstinate and destructive lesion in that form of the disease first described by Morvan and named for him. These whitlows are painless and chronic, and they often destroy the ends of the affected fingers. Abscesses may occur in various places. Arthropathies are not unusual in syringomyelia. They are very similar to those occurring in locomotor ataxia. They cause great deformity of the joints affected, with exudation within the capsule, increase in the articular surfaces, denudation of bone, stalactites, etc. Any one of the large joints, either the knees, shoulders, elbows, hips, or ankles, may be involved: occasionally more than one joint suffers. Fragility of the long bones, leading to easily-produced fractures, occurs.

Deviation of the spine is a very common affection in syringomyelia. Bruhl says it is present in 50 per cent. of cases. The most common form of deviation is scoliosis. In the author's case this scoliosis was so marked in the neck that it presented the appearance of torticollis. It is most marked usually in the dorsal region. Kyphosis is the next form in frequency, and lordosis the last. Scoliosis may be an early symptom of the disease. Many theories have been advanced to account for this symptom, but that of Roth, who attributes it to an atrophy of some of the transverse muscles of the spine, appears to us the most reasonable.

Vaso-motor disturbance may be shown by œdema or coldness of the extremities, or by burning sensations in them, by excessive sweating and by persistence of lines, marks, or maculæ left after contact of objects with the skin. Pilocarpine by injection, according to Dejerine, is delayed in its action, and causes much more abundant sweating in the analgesic regions than in other parts.

Affections of the sphincters are certainly rare in syringomyelia. They might occur in extreme cases in which the cavity in the cervical region was so expanded as to act as a total transverse lesion. Yet in the author's case, in which the expansion was extreme, there was no interference with the innervation of either the bladder or bowel.

Pupillary and oculo-motor symptoms have been reported. The sympathetic centre in the cervical cord may be either paralyzed or irritated, causing contraction or dilatation of the pupil as the case may be. When the bulb is involved, the symptoms of bulbar palsy may appear. In Taylor's recent case the aqueduct of Sylvius was dilated, probably causing, by involvement of the underlying nuclei of the third nerve, the nystagmus which his patient had.

The second class of symptoms observed by us includes those caused by involvement of the white matter of the cord. These are, briefly, the symptoms, first, of lateral sclerosis; and, second, those of posterior sclerosis. It can easily be understood that a widely-extended destructive process, like syringomyelia, in the cervical region, must involve inevitably some of the fibres in the white matter. The extent of this involvement of course varies. The most common is lateral sclerosis. This produces, as is well known, spastic paresis in the legs. The knee-jerks are exaggerated, ankle-clonus is present, the gait is feeble, the muscles are spastic, but not wasted, and the innervation

of the bladder and rectum is not affected. The symptoms of posterior sclerosis, or locomotor ataxia, are not so common. Ataxia, however, and swaying with closed eyes, may be present, possibly dependent upon involvement of Clark's column and the ascending cerebellar tract. Fulgurant pains are rare.

The brain is not involved in typical cases of syringomyelia. The author once saw, however, a diffuse gliomatous lesion in the mid-brain and cerebellum which strongly suggested an identity, in all but position, with the gliomatosis of the cord.

Diagnosis.—The diagnosis of syringomyelia rests upon the recognition of certain groupings of the various symptoms already described. The most common grouping is that of muscular atrophy, especially in the shoulders and arms, spastic paresis of the legs, the "dissociation" sensory symptom, and a variety of trophic disorders. The most characteristic of these symptoms is the peculiar disorder of sensation. Hysteria may simulate this sensory change, but it does not present true muscular atrophy. Anterior poliomyelitis does not cause sensory changes. Amyotrophic lateral sclerosis is undoubtedly identical in some reported cases with syringomyelia. Tumors of the cord and localized myelitis may closely simulate the disease, and can best be distinguished by the history of the case and a careful study of the sensory and trophic disorders. Trophic changes may be conspicuous, and direct the attention from other symptoms. Thus, destructive whitlow, described as Morvan's disease, is a type of syringomyelia. Friedreich's ataxia has some analogies with syringomyelia: Griffith's statistics prove that 25 per cent. of autopsies in the former present cavities in the cord. Cases of precocious locomotor ataxia ought to be most carefully studied for the symptoms of central gliomatosis. Finally, hemiplegia and monoplegia have been caused by syringomyelia; they could probably be distinguished by sensory and trophic symptoms.

Prognosis.—The course of syringomyelia is slow, but its termination is never favorable. Many patients die from some intercurrent affection.

Treatment.—There is no specific, or even palliative, treatment for such an inveterate degenerative process as that which produces syringomyelia. It is possible only to treat some of the isolated symptoms, to preserve the strength, to guard against accidents, and to avert the tendency to death by intercurrent disease.

HEREDITARY ATAXIA.

By ARCHIBALD CHURCH, M. D.,

Chicago.

Hereditary Ataxia, or hereditary ataxic paraplegia, also known as Friedreich's disease, is a form of spinal sclerosis appearing usually before twenty years of age, with marked hereditary features. It is usually characterized by generalized ataxia beginning in the legs, by nystagmus, and by impairment of speech, and pursues a chronic progressive course.

As compared with Friedreich's description of this interesting disease published in 1863, this scant definition is too brief; but succeeding groups of cases observed in various parts of the world, practically of a similar nature, have shown that features of the malady at first insisted upon as essential are not invariably present or even usual. Cramped by the rigid lines of the early description, many observers have either slavishly followed, seeing only what had been before pointed out, or, if finding marked variations, regarding them as unusual and anomalous. Even Ladame so late as 1890 erected a clinical criterion which does not include a very fair proportion of these cases, although at that time some two hundred had been published, and probably very many more overlooked because of the false standard of measurement that was, and still is, followed. Gray, for instance, in his recent work, states as a "cardinal symptom" that "the knee-jerk is always absent," and Gowers looks upon the report of a case beginning at sixty-six years of age as a coincidence to be relegated to a foot-note. As a matter of fact, aside from the ataxia and perhaps the family history, no single item can be insisted upon in every case, yet the symptom-group is a very striking one, and the numerous variations are merely the expressions of an unsystematized and widely-distributed lesion.

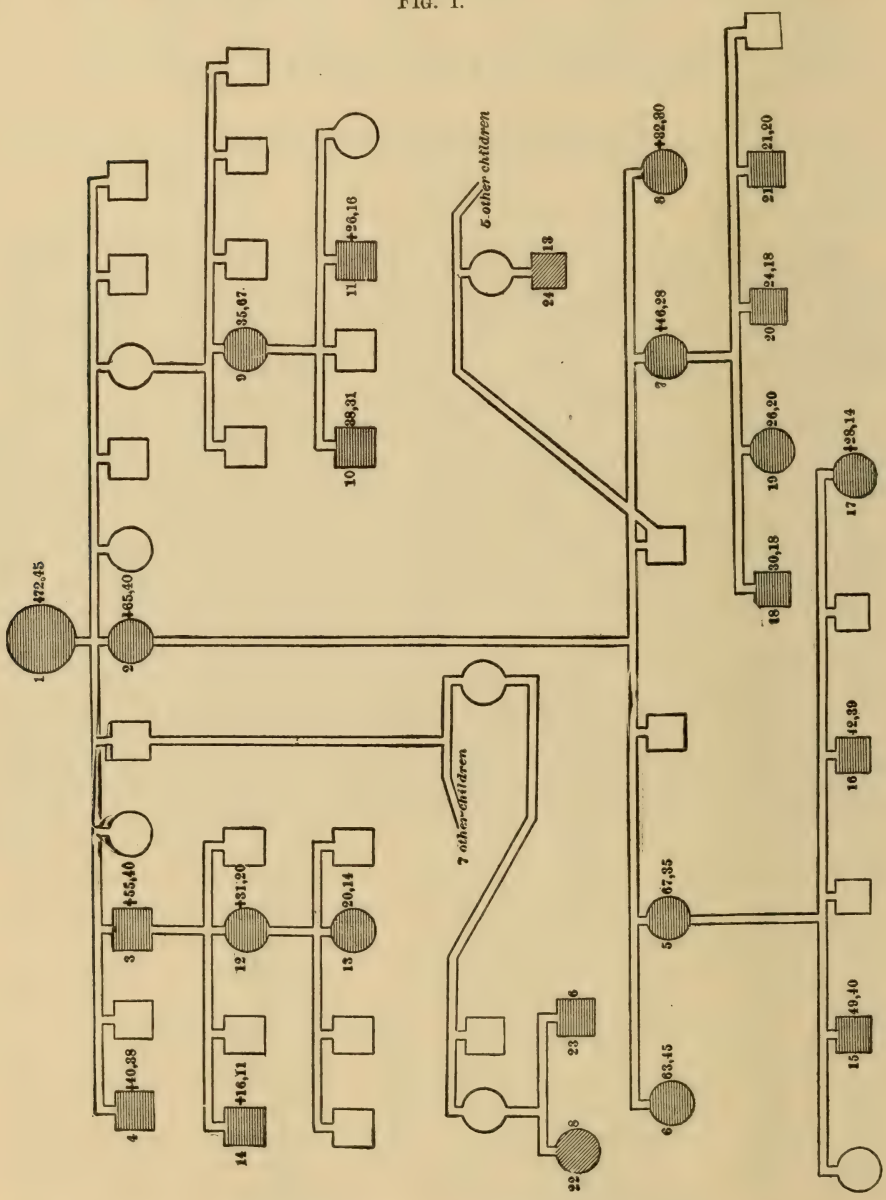
Etiology.—The most striking fact in this disease is its transmission from generation to generation, either in the same form or by related sclero-neurotic disease, and the increasing susceptibility that is encountered in the later generations, where it numbers many members of the same immediate family and shows a distinct tendency to appear at a constantly earlier period of life. In this way may be explained the fact that many of the progenitorial cases have been misunderstood, overlooked, or misclassed. In this connection I wish to refer to the instructive family tree published by Sanger Brown,[1] and here reproduced by his permission. (Fig. 1). Nonne describes a somewhat similar group, and the one post-mortem obtained showed only an abnormal smallness of all the parts of the spinal cord, a deficient development which had not taken on sclerotic degeneration. Occasionally a generation escapes this disease, but atavism is likely to occur. The developmental defect is therefore strongly pronounced, and constitutes the background of the picture. It is as if portions of the nervous system, especially of the spinal cord, were incapable of maintaining their functions in accordance with the demands of growth and active life,

[1] *Chicago Medical Recorder*, Feb., 1892.

and underwent regression, producing the sclerotic changes to be described later.

The developmental periods of life are those at which it is most likely to

FIG. 1.



Family Tree of Hereditary Ataxy, reported by Dr. Sanger Brown.

Explanation of Diagram.—Shaded enclosures indicate Hereditary Ataxy. Squares indicate males, circles females. The numbers to the left refer to the cases in Brown's paper; the first number to the right the age at death or the present age. † indicates deceased. The last number indicates the age at onset.

appear—the seventh and eighth years of age, the age of puberty, and at about twenty, the age of full physical and sexual strength. But it sometimes is congenital, and may appear at any period of life. This is clearly shown in the

PLATE XIX.



1



2



3



4

1, 2, 3, 4. The F. Family.—Showing Apathetic Facies Increasing with Duration of Disease:

1. Tina F., Five years old, unaffected.
2. Oscar F., Eight years old, affected one year.
3. Frederick F., Seventeen years old, affected three years.
4. Rose F., Twenty years old, affected five years, helpless.

PLATE XX.



5



6



7



8



9

5, 6, 7. The S. Family.—Showing Facies:

5. Ella S., Nineteen years old, affected two years, slightly.

6. Miles S., Twenty-five years old, affected four years, cannot walk.

7. Hugh S., Twenty-nine years old, affected fourteen years, helpless.

8. Lucy R., Sixteen years old, affected one year, shows mask-like face.

9. Alfred W., Nineteen years old, affected four years. A sister similarly affected at sixteen years of age met an accidental death at twenty-one.

8 and 9 have increased reflexes and double ankle-clonus.

2, 3, 4, 5, 6, and 7 have knee-jerks abolished.

3, 4, 6, and 8 show nystagmus in the photographs.

In 2, 3, 4, 6, 7, 8, the head was so much affected that it required to be supported by pillows to make a four-second photographic exposure.

remarkable series of Brown and of Nonne, in the cases reported by Wells, and in the instances of Everet Smith. The sexes are about evenly affected, though in some family groups males or females greatly predominate, and it is somewhat more liable to be transmitted through the females than by the male branches, probably because the males affected early do not marry, and in later cases are impotent.

Pathological Anatomy.—With the exception of a few cases, notably one reported by Menzel, post-mortem changes in the nervous matter have been confined to the spinal apparatus, including the posterior nerve-roots and an occasional peripheral nerve, and to the cranial nerves, especially the hypoglossal, optic, and motor-oculi, and their centres in the medulla. In Menzel's case gross changes were traced into the cerebrum and cerebellum, and the latter was markedly atrophied. Very few autopsies are on record, however.

The change in the spinal cord is histologically practically identical with that in ataxic paraplegia and locomotor ataxia, for a full description of which the reader is referred to articles on those diseases. Dejerine and Letulle, however, basing their observations on a single case, claim that the sclerosis in this disease is peculiar in being confined to neuroglial hyperplasia without vascular changes. The distribution of lesions is the matter of most interest, for upon it depends the preponderance of symptoms in any given case. In every instance subjected to a post-mortem examination, except Nonne's, the postero-internal and postero-external columns have been found involved throughout the entire length of the cord. In the large majority of cases the pyramidal motor-tracts in the lateral columns have been sclerosed, and this process has, at different levels in different cases, invaded the anterior horns, the anterior columns, the direct cerebellar tract, and the posterior roots. The tract of Lissauer and Clark's columns usually escape. It is this multilocular distribution of the sclerosis which gives rise to such a variety of clinical manifestations and accounts for the confusion in literature. It is apparent that as the posterior columns or the pyramidal tracts are principally involved, the locomotor and spastic symptoms will vary, just as occurs in ataxic paraplegia. It is not incredible that even knee-jerks lost early in a case may later reappear, or myotatic irritability of a highly exaggerated type subsequently diminish or entirely fail.[1] The lesion has been traced through the medulla and pons involving the post-pyramidal nucleus. In the posterior columns it is that of an extremely intense tabes, and the involvement of the posterior roots is also analogous, but less marked. In the lateral columns it is that of spastic paraplegia plus the involvement of the cerebellar tract, the anterior direct motor-tract, and the frequent implication of the anterior horn.

Symptoms.—Unsteadiness upon the feet, a tendency to tumble, and clumsiness are the first noted indications. Ordinarily the symptoms advance slowly. As a rule, and in the type of Friedreich, the knee-jerk is lost very early, but the writer now has two cases under observation in which it is greatly exaggerated, and in both of them there is ankle-clonus. A number of Brown's cases also show increase of myotatic excitability, and the same thing has been not infrequently recorded. The superficial reflexes may be present or absent. Sexual power is frequently undeveloped or disappears, though in one of the cases under the writer's care, where the deep reflexes are prominently increased, sexual inclination is pronounced. As the case advances the ataxia increases, though standing with the eyes closed is often possible when the gait is sprawling and extremely bad. The trunk may be involved, so that, in sitting on a chair without arm or back support, marked swaying is

[1] In one of the writer's cases an ankle-clonus is rapidly diminishing.

present. The gait is simply staggering. The stamping of tabes is rarely seen, and even in the cases marked by clonus and exaggerated knee-jerks the stiff-legged gait of spastic cases is absent or only slightly present. Eventually, the upper extremities and the neck are involved, so that the patient becomes practically helpless, and the head, under very little control, rolls around on the shoulders. From the implication of the musculature of vocalization speech is characteristically modified. It is drawling, with the accent and modulation misplaced, hesitating, sometimes slightly explosive; in a word, ataxic. Usually early, and almost invariably late, in these cases nystagmus is present. It is readily overlooked if the patient be not examined carefully. It is not constant, subsiding when the line of vision is directly forward, and only occurring when the eyes are moved. Early in the disease it is necessary to have the eyes turned sharply outward, upward, or outward and upward to demonstrate it. The nystagmic movements are of comparatively short range, unequal in length, and tend to subside as the eyes settle down to the new position, seeming to the writer to be part and parcel of the general lack of balance in the entire voluntary muscular apparatus. A few instances of temporary strabismus and diplopia are on record. Pupillary symptoms and optic atrophy are absent in the Friedreich type, but frequent in Brown's cases.

There is not much pain, even in the markedly ataxic types; the lightning pain of locomotor ataxia, the girdle sensations, and the visceral crises are absent, but dull rheumatoid aching, pain on starting micturition, and painful cramps at night are not infrequent. Until late in the course of the disease errors of sensation are slight or absent. Slight anæsthesia, retardation in the transmission of sensations, variations in sensitiveness relative to temperatures, pressure, and electricity, have all been occasionally noted.

Muscular power is ordinarily greatly reduced, but paralysis only appears very late, and is comparatively of moderate extent. Sometimes there is distinct atrophy, owing either to the involvement of the anterior horns or to an occasional peripheral neuritis, and it is only in these cases that any notable changes in electrical responses are found. After the patient is bedridden general emaciation ensues. A coarse tremor is sometimes present, and choreoid movements of head and limbs of an ataxic character, ceasing when the part is supported, are common.

The facial appearance of these cases, when the disease is moderately well developed, has not received sufficient attention. The lines of expression are lost, the jaw drops, the mouth is partly open, the eyelids droop and look heavy, the whole expression or lack of expression is of apathy, and even of imbecility. In some families the change in the face has been the first intimation to their relatives, familiar with the type, of the invasion of the malady, though an intelligent examination would probably have sooner discovered it. This facies is imperfectly shown in the series of photographs published herewith. When pleased or disappointed, emotions are tardily and clumsily or grotesquely shown in their faces, which shortly return to an appearance of blankness. The mind is not necessarily impaired, but mental enfeeblement has resulted in some cases, and the enforced inactivity leads, perhaps naturally, to some hebetude. The drooping head, the scoliotic spine, and clubbed foot, which are common, are other evidences of muscular weakness and lost synergism. Sexual attributes are greatly delayed in the younger cases or fail entirely to develop, giving the patient a childish appearance and bodily formation.

Course.—The disease is essentially chronic, and very rarely the immediate cause of death, which results from intercurrent maladies, to which the inactivity of the patient in some instances no doubt conduces. Some cases have

lasted over forty years, and some have terminated in two or three. As in other respects, there is in this regard a striking similarity among the members of any family group, but it is not unusual to see the younger members of such a family attacked at an earlier age and in a more active manner. Some cases present long-stationary periods or even temporary slight improvement under treatment and bettered conditions of life. The progressive tendency, however, toward physical helplessness is apparently invariable; and even after the patient is bedridden life may last many years with ordinary care, as there seems to be no especial liability to bed-sores or other dystrophic condition. Occasionally acute myelitis has terminated the case.

Diagnosis.—The diagnosis hangs upon the youth of the patient, the slow onset, the history or presence in the family of other similar cases or of instances of spinal or cerebral sclerosis (among which paretic dementia should be included), upon the ataxia, the nystagmus, the halting peculiar speech, and possibly upon the facial appearance. Absence of locomotor pains, of pupillary symptoms, of acquired syphilitic infection, and of pronounced sensory disturbances are negative conditions of corroboratory value.

Treatment.—The prognosis is always grave, as has already been implied, and treatment seems to be of exceedingly little value. A course of arsenic, of massage, of stretching the spinal column, especially by Benedickt's method, have all apparently caused slight amelioration in progressing cases. Those measures recommended in tabes should be tried, and cauterization with the thermo-cautery over the spine repeated at intervals of two weeks may be employed for a prolonged period. A light touch of the smallest point opposite each vertebra is quite sufficient and not particularly painful. General measures to maintain the physical state are of course always in order. With young patients it is well to allow a reasonable amount of instruction, as they are often dependent upon themselves for entertainment during long years of helplessness.

RAYNAUD'S DISEASE.

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In a thesis published at Paris in 1862, Maurice Raynaud first called attention to a complex of symptoms to which, for want of a more satisfactory title, he gave the descriptive name "Local Asphyxia and Symmetrical Gangrene of the Extremities." This essay was founded upon the clinical histories of 25 cases collected from various sources, only five of which came under his personal observation. Some of the cases drawn from other sources dated back many years and were very inadequately reported, but Raynaud succeeded in presenting a clinical picture that was at once recognized by his contemporaries, and which soon took a place in medical literature as a new disease worthy to be named for the author who first described it. In this and later studies Raynaud defined the disease as "a neurosis characterized by enormous exaggeration of the the excito-motor energy of the gray parts of the spinal cord which control the vaso-motor innervation." The stage of cyanosis he considered as due to a spasmodic closure of the arterioles of the parts affected, with a regurgitation of venous blood into the capillaries: and if this condition was continued sufficiently long, gangrene of more or less gravity supervened. This gangrene, which is often strikingly symmetrical in its distribution, he distinguished from all other varieties of local death as not being due to embolism, thrombosis, or changes of an inflammatory character in the intima of the blood-vessels. There can be no doubt that many of the cases subsequently described under this name, and indeed some of those collected in Raynaud's original thesis, do not properly come within the definition laid down by this author. So recent a writer as Sturmdorf, of New York (*Medical Record*, Aug. 1, 1891), goes so far as to question the existence of such a disease, which, he states, cannot be diagnosticated during life; for, "admitting the possibility of excluding all other conditions capable of producing gangrene, we must exclude" that form of "endarteritis [Meigs] whose presence could be demonstrated only on the post-mortem table, and whose absence is a sine quâ non to the acceptance of Raynaud's disease in the sense of its author's conception." It is quite probable that modern pathology may succeed in disproving the existence of Raynaud's disease as a morbid entity, but it is certain that there are a sufficient number of cases on record—and, curiously enough, many of them are in children—which bear out in all essential respects the original clinical picture.

The leading characteristic of the disease consists of paroxysms of more or less continuous and complete spasm of the arterioles of the extremities, usually occurring, with a fair degree of symmetry, upon like parts of the two hands or two feet, or upon both hands and feet, or—and this less frequently—upon other symmetrical regions, such as the ears, sides of the nose, or buttocks. This spasm, if sufficiently long continued, gives rise to more or less extensive trophic changes, or even death of the parts involved.

Symptoms.—As originally described by Raynaud, this affection may be conveniently divided into three principal stages: 1, Local Syncope; 2, Local Asphyxia; 3, Gangrene. The first stage, local syncope, may be transitory, or even wanting altogether, but when the disease assumes its severest form the second and third stages always occur in the order named.

Local Syncope.—This term was employed by Raynaud to designate a condition, usually of one or more fingers or toes, which in its slightest manifestation is not incompatible with health. The patient, usually a female of neurotic temperament, after exposure to slight cold, or even under the influence of moral emotion, observes one or more of the fingers become pale and cold. The skin assumes a dead-white or parchment-yellow color, cutaneous sensibility is quickly abolished, and the digit feels icy-cold and dead. While tactile sensibility may be for the time abolished, the heat-sense may still, in a measure, be maintained. At times a cold perspiration may cover the affected part, while at others it is dry and shrivelled as if frozen. This spasm of the arterioles, with the consequent temporary abolition of local circulation, which is popularly known as "the dead finger," is insignificant from its transitory duration, being succeeded by a variable period of usually very painful reaction, in which the blood gradually returns to the part. It is simply an exaggerated form of what so commonly occurs after the hands have been exposed to a low temperature when confined in tight kid gloves. This, the slightest and in some cases the only stage of the disease, has been but rarely observed in children.

Local asphyxia, or cyanosis, may be preceded for a time by more or less frequent occurrences of local syncope, or may be the first manifestation of the disease. In the latter case the onset is generally sudden, but sometimes is preceded by paræsthesiæ or pain, usually limited to the fingers or toes about to be affected. After exposure to a more or less marked depression of temperature, or even without appreciable cause, one or more fingers or toes become cold and usually somewhat swollen. The particular phalanx or phalanges will be found to have assumed a dusky or cyanotic tint and to feel icy-cold to the touch, while the whole limb is colder than the rest of the body. Tingling or shooting pains of varying severity are felt, and hyperæsthesia or anæsthesia of the parts may be observed. The cyanosis affects most intensely the distal portion of the phalanx, but it may extend in decreasing degree as far upward as the wrist-joint or ankle, or may even pass beyond, while venous marblings may be traced far up the limb. This condition may affect one phalanx or several in varying degree, either upon a single limb or upon both hands or feet, or even upon all four extremities. When both hands or both feet are affected, the degree of cyanosis is generally more marked upon one side; and in some paroxysms in the same patient the asphyxia may be confined to one member alone, while in others both feet or both hands or a hand and foot are affected. In any particular case, however, in the successive paroxysms local asphyxia generally involves the same phalanx or manifests the same order and intensity of involvement of several phalanges. After a variable duration the cyanosis gradually passes away and the parts regain their color; this reaction may even be excessive, and redness and burning pain be noted. Such paroxysms vary greatly in severity and duration. In some instances the attack passes off in a few seconds, to be frequently repeated at the slightest exposure to a change of temperature; while in other cases it is prolonged for several hours or even several days. Pain is also a very variable symptom, some patients experiencing little discomfort during the asphyxial attack, while others complain bitterly of intense burning sensations in the part. As with the preceding stage, local asphyxia may be the most serious manifestation of the

disease, and in this case we find it occurring at irregular intervals, but often as frequently as several times daily, usually during the winter months, being provoked by the slightest exposure to cold.

A symptom frequently noted during this stage is hæmoglobinuria, to which attention has been lately directed principally by the observations of Barlow and Southey in England. Shortly after the beginning of a paroxysm of local asphyxia the child may pass very dark urine, which is found to contain albumin, and responds to the guiacum test for hæmoglobin. Both Southey and Barlow report cases of this kind in which, during some of the paroxysms, the urine was found to contain no blood-corpuscles, but showed fine granular brown débris and a profusion of oxalate-of-lime crystals. This phenomenon does not occur after every attack; but it has been observed that a copious deposit of urates may at times replace the loss of hæmoglobin. It is most likely to occur when the attack is preceded by yawning, drowsiness, nausea, or pain in the belly referred to the ensiform cartilage, which are the symptoms preceding hæmoglobinuria due to other causes.

When an attack of local asphyxia has lasted several days, the nail ceases to grow, and the occurrence is marked upon the nail by a transverse striation of variable distinctness. When paroxysms have frequently occurred, the affected digits may become rather soft and flabby from an increase in the subcutaneous fat.

General symptoms are very slight, and fever, if present, does not usually exceed 100° F: if higher, it is attributable to other causes. A stage of local erythema has been said sometimes to replace the asphyxial stage, being ascribed to an irritation of the vaso-dilator nerves; but it has rarely been followed by gangrene, and would seem more properly to be classed as the erythromelalgia of Weir Mitchell. In rare cases the tip of the nose or the ears, and occasionally other symmetrical regions of the body, may be affected with local asphyxia, but the symptoms are the same as in the more common variety.

Gangrene.—When local asphyxia persists sufficiently long, the vitality of the part suffers. Small blebs form upon the tips of the affected digits, partly at the expense of the outer layer of corium; these rupture, discharging a serous or sero-purulent, often blood-stained, fluid, and leave an excoriation which heals with some little loss of substance. When this process has attended repeated attacks, the fingers or toes exhibit numerous little white cicatrices, and become somewhat conical in shape, with distorted nails and shrunken parchment-like skin. In the severer cases the destructive process may involve a more extensive portion of one or more digits. In this event there are no phlyctenulæ, but the part at once assumes a dark violet or blackish color, and passes through a condition similar to senile gangrene, with subsequent elimination of the sphacelus—a process requiring usually two or three weeks. And thus the patient may pass through an attack with the loss of one or more distal phalanges, or even more extensive portions of the member. Loss of a portion of the margin of the external ear may thus occur, but similar loss of substance of the tip of the nose has rarely, perhaps never, been observed.

Many cases of symmetrical gangrene of greater severity than here described have been reported as Raynaud's disease without seemingly good grounds. Some of these have shown concomitant constitutional symptoms which throw grave doubt upon their accepted pathology; and in others, again, ergotism or vascular disease has not been satisfactorily excluded. As seen in children, where the ground is considerably clearer, the most carefully studied cases have rarely shown lesions more serious than those above described.

Etiology.—As far as its occurrence in children is concerned, sex or age

seems to have little influence. It occurs most commonly during the winter months, often being excited by exposure to the slightest depressions of temperature. Heredity seems to play some part. Raynaud observed a female infant who exhibited a marked disposition to local asphyxia during the first five months of life, at a time when her mother was passing through attacks of dry gangrene of all the extremities. A neurotic family history must be accepted as a powerful predisposing cause, since many victims of this disease show a distinct nervous inheritance. Makins saw symmetrical gangrene in a brother and two sisters whose mother had died of progressive muscular atrophy; and Colman and Taylor report local syncope in a girl of ten years, whose mother was extremely neurotic, and whose maternal grandfather and grand-uncle had suffered from similar local syncopal attacks. As regards previous conditions of health, in some cases the disease has followed upon acute and depressing illnesses; but in others no such exciting cause could be assigned.

Pathology.—Raynaud ascribed this affection to an exaggerated vaso-constrictor irritation dependent upon an increased excitability of the vaso-motor centres of the cord, since, according to his observation, galvanization of the cord modified the arterial spasm, and in one case, carefully studied by himself and Galezowski, there was a remarkable coincidence between the peripheral circulatory disturbances and like phenomena observed in the retinal vessels. Weiss, however, inclined to the theory of peripheral irritation arising in the skin, viscera, or the brain, and thus ascribed many of the cases observed in neurotic women to uterine or ovarian irritation. As the disease is rarely in itself fatal, no satisfactory pathological study has as yet been possible. The most important addition to our recent knowledge of the disease is the occurrence of intermittent hæmoglobinuria. Of ten children suffering from local asphyxia and symmetrical gangrene, as reported principally by English observers, at least eight at some time during the course of the disease exhibited undoubted evidence of blood coloring-matter in the urine. Dickinson, the chief English authority on renal diseases, states that the two conditions, Raynaud's disease and intermittent hæmoglobinuria, seem so to approach each other and mingle as to render it impossible to make a distinct demarcation between them. Abercrombie holds that we are warranted in believing that both paroxysmal hæmoglobinuria and Raynaud's disease are symptoms of a more general affection, and he suggests that the jaundice sometimes found after attacks of hæmoglobinuria (and also after attacks of local asphyxia) is the result of arterial spasm of the hepatic vessels. But it seems more probable, as Barlow believes, that this jaundice is due rather to breaking up of blood coloring-matter elsewhere in the circulation. Several observers have noted that during a paroxysm of intermittent hæmoglobinuria blood drawn from a cold extremity showed changes in the red corpuscles, which exhibited a decided tendency not to form rouleaux and appeared markedly crenated, with granular masses in the surrounding serum. In a very interesting case of a boy of twelve years, who manifested both intermittent hæmoglobinuria and local asphyxia of the extremities, with gangrene of the tips of the ears, Myers found that blood taken from ears and hands during an attack of hæmoglobinuria showed changes similar to those just described. It is thus seen that in this case blood-changes, local asphyxia and gangrene, and hæmoglobinuria occurred in the same patient.

This association with paroxysmal hæmoglobinuria at once suggests a relation to malarial infection—a relation which, in not a few cases at least, is borne out by the existence of previous malarial attacks in such patients. Hereditary syphilis also has obscured the earlier history of several children suffering from well-marked Raynaud's disease; and it is doubtful how much of the symptoms

in these cases could be attributed to specific endarteritis capable of causing vascular obstruction. It is noteworthy, perhaps, that both Boas and Murri, as well as Flensburg more recently, mention syphilis together with ague as probable etiological factors in the production of hæmoglobinuria.

Course, Duration, and Results.—As observed in children, symmetrical gangrene pursues a more benign course than in adults. Local asphyxia may be the only stage, and the disease may be a regular accompaniment of cold weather, disappearing as summer approaches, to recur the next winter. Paroxysms may occur frequently during the day on the slightest exposure to cold, or they may be seen at irregular and longer intervals. Other cases may terminate speedily in gangrene, and leave the child with deformed fingers or toes and only a tendency to blueness of these extremities after exposure to severe cold; while, again, the repeated occurrences of superficial sloughs may result in painful conical fingers with blunted tactile sensibility.

Diagnosis is comparatively easy, provided satisfactory exclusion can be made of cardiac or vascular disease, diabetes, frost-bite and ergotism. From chilblains it may be distinguished by the history, by the absence of itching, and by the presence of pain during spasm which passes off after relaxation. Its localized character at once serves to exclude congenital cyanosis.

Prognosis.—As regards life prognosis is almost always good. Only in one or two reported cases in very debilitated children has a fatal result been traceable to exhaustion from the disease. The prospect of its duration as a chronic or subacute condition or as a periodical visitation is not to be disposed of so easily, and there seems to be no means of judging upon this point at any time during the earlier paroxysms of the disease. The occurrence of hæmoglobinuria, so far as yet observed, has not proven more than a curious episode without much serious import. It is possible, however, that aggravated forms may occur in which a more profuse loss of blood may seriously affect the outcome of the case.

Treatment.—When the milder stages of this disease are first manifested much may be done to prevent the more serious results of repeated paroxysms. If the general health and constitution of the child be satisfactory, and the symptoms seem to depend entirely upon exposure to cold, great care must be exercised to guard against all chances of chilling of the surface or the extremities. He should not be sent out into the open air until he has partaken of food; woollen underclothing and stockings must be constantly worn. If the child is ill-nourished or cachectic, a plentiful supply of nourishing food and appropriate constitutional treatment must be secured. Imperfect circulation of blood and coldness of the extremities certainly predispose to attacks of local asphyxia, and therefore douches may be ordered, the effect of which must, however, be carefully watched. A rapid sponging in a bath of water at a temperature of about 100° F. may be followed by a douche of colder water of about 70°, emptied upon the back and shoulders as the child sits in the warm water. This bath, which is best given in the morning, together with a few minutes' exercise with a skipping-rope or football after breakfast, will do much to keep the extremities warm during the day. By this means attacks of local asphyxia may be prevented; but if they should occur care must be taken not to employ the bath while any blueness of the extremities is noticeable, nor for some hours after the subsidence of a paroxysm.

Raynaud was the first to call attention to the beneficial influence of galvanism applied in the form of descending currents either to the spine or down the affected extremity. In the former case the positive pole is applied over the fifth cervical vertebra, the negative near the commencement of the cauda

equina; while in the latter the negative pole is applied to the closed fingers or the toes. Barlow has obtained most satisfactory results by placing one electrode on the upper part of the limb and the other in a basin of warm salt water in which the affected extremity is immersed. As many elements as the patient can bear should be used, and the current should be made and broken at frequent intervals. The séance should be given daily for about ten minutes. Shampooing is often valuable in conjunction with galvanism, especially in the chronic forms in which the extremity of the limb undergoes atrophy.

Beyond an appropriate tonic treatment little is to be expected from internal medication. Quinine is the only drug whose use in some cases has apparently produced beneficial results, as might be expected from the frequent association with symptoms which suggest the probable etiological importance of malarial infection. This drug should certainly be given a fair trial in every case. Nitrite of amyl has been tried during the asphyxic stage upon theoretical grounds, but without any observed effect.

If pain is severe, much relief will be experienced from the local use of chloroform liniments. In some cases, curiously enough, cold applications, like the ice-bag, give greater relief than warmth.

When gangrene has begun the limb should be maintained in an elevated position, well wrapped in cotton, and kept clean with an antiseptic wash. Stimulants may be required in this stage, and occasionally hypnotics and sedatives to secure sleep, allay restlessness, and alleviate pain. When the line of demarcation has formed, dry hot applications should be kept to the part to favor the process of elimination and repair. In rare cases the destruction of tissue may be so great as to demand a more or less formal amputation.

PART VIII.

DISEASES OF THE RESPIRATORY SYSTEM.

DISEASES OF THE NOSE.

By W. E. CASSELBERRY, M. D.,

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I. Acute Rhinitis.

Acute Rhinitis, colloquially termed "cold in the head," is an acute inflammation of the mucous membrane lining the nasal cavities from the anterior nares to the naso-pharynx. It is prone to extend to adjoining mucous surfaces, and usually embraces the naso-pharynx, at least to some degree, and thence invades, not infrequently, the middle ear.

Etiology.—Reasoning from analogy and from its pathology and clinical history, we must regard acute suppurative rhinitis as an infection by pathogenic micro-organisms, although germs specific to this particular form of suppuration have not, as yet, been identified. This statement, however, will bear indefinite qualification, which we must limit to two phases: 1. Some special predisposing condition of the part is essential to infection. 2. It follows certain exposures with such regularity and precision that we must infer a causal relationship between chilling of the body and rhinitis. A draught between the shoulders, permitting the feet or other parts of the body to become cold and damp, or too rapid checking of the perspiration, causes, through the intervention of the vaso-motor nervous system, a sudden turgescence of the nasal vessels, especially of of the turbinated bodies. In the majority of instances this congestion is but transitory, passing off in a few minutes or a few hours, and followed merely by increased mucous secretion; but in other instances it does not subside, but augments in violence, and is followed in from twelve to twenty-four hours by a muco-purulent, and then almost a purulent, discharge. The congestion of the nasal vessels occasioned by thus "taking cold" evidently favors a microbic invasion of the mucous membrane by impairing, in some manner, its powers of resistance.

Instances are not wanting of direct infection of one person by the discharges of another—an accident which is apt to happen among children by the use of handkerchiefs in common. Suppurative rhinitis in infants is also attributable to direct infection from the vaginal discharges during birth.

Symptoms.—A sense of stuffiness in the nostrils, with burning and dryness, together with slight febrile reaction, is succeeded in a few hours by an acrid watery discharge, which later leads to a free muco-purulent secretion. A simultaneous congestion of the frontal sinuses, which occasions headache, is frequent, but this does not argue pressure by accumulated muco-purulent secre-

tion within these cavities, for actual empyema of the frontal sinuses is very rare. Mere swelling of the orifice of the Eustachian tube will occasion tinnitus aurium and impairment of hearing, and a direct extension of the inflammatory process to the middle ear is, seemingly, the cause of nearly all cases of abscess of the cavity of the tympanum. Certain individuals, and even certain families, manifest a decided predisposition to this complication. Associated conjunctivitis is common, and, at times, the external nasal appendage appears swollen, florid, and excoriated by the irritating discharges.

Treatment.—It is much too customary to permit this acute inflammatory disease of a delicate part of the body to progress without efforts to mitigate and abbreviate it. Such a course is fraught with immense possibilities of ultimate damage, chronic catarrh of the nose and accessory organs being thereby established. Many remedies are of real service, but a multiplicity of recommendations is confusing and tends to lessen confidence in any one line of treatment. We will therefore describe simply our own methods of dealing with these cases.

If it is sought to abort the attack of rhinitis, a single average-sized dose of Dover's powder, proportionate to the age of the child, is given at bed-time, also a laxative if needed. The patient is especially well covered in bed, outside night air is excluded, and the temperature of the apartment maintained during the night at 60° to 69° F., but no effort is made to produce profuse perspiration.

The following day, or even the first day if called upon to prescribe before evening, this formula will meet the indications:

℞. Tr. aconiti . . . . . ♏xij.
Tr. belladonnæ . . . . . ♏xxiv.
Morphinæ sulphatis . . . . . gr. ¼.
Potassii bromidi . . . . . ʒj.
Spts. menthæ piperitæ . . . . . ♏xx.
Aquæ . . . . . q. s. ad fʒiij.—M.
Sig. Adult dose, one teaspoonful every hour, to be lessened for children according to age.

The same ingredients could readily be prepared in the form of a capsule, pill, or compressed tablet.

Local treatment is of the utmost importance, and the following mixtures render satisfactory service by atomization:

Spray No. 1.

℞. Cocainæ hydrochloratis . gr. ij.
Sodii boratis . . . . . gr. xx.
Sodii bicarbonatis . . . gr. xx.
Ol. eucalypti . . . . . ♏j.
Ol. gaultheriæ . . . . ♏j.
Thymol . . . . . gr. j.
Menthol . . . . . gr. ss.
Glycerini . . . . . fʒss.
Aquæ . . . . q. s. ad fʒj.—M.
Sig. Dilute, adding one or two teaspoonfuls to one ounce of warm water for use as a spray.

Spray No. 2.

℞. Cocainæ hydrochloratis . gr. ij.
Ol. pini Canadensis. . . ♏v.
Ol. gaultheriæ . . . . . ♏ij.
Ol. eucalypti . . . . . ♏ij.
Thymol . . . . . gr. ss.
Menthol . . . . . gr. j.
"Vaselin oil" . . . . fʒj.—M.
Sig. Use with double bulb (Davidson) atomizer, either alone or following the use of Spray No. 1.

For young children, who are often terrified by spraying, may be substituted a small syringe or an ordinary medicine-dropper used as a syringe, with which

to project, gently, either of these solutions through the nostrils. Spraying or gentle syringing in this manner may be performed twice or three times daily, or even every three hours in severe cases. The cocaine can be omitted from either spray formula, if there be any objection to its use, without seriously impairing the effectiveness of the remedy. All solutions for nasal use should be somewhat warm.

Of the many inhalations, we will mention only camphorated steam as a domestic remedy of power. It is conveniently used by placing a pint of steaming hot water in a glass fruit-jar and adding two fluidrachms of spirit of camphor. A funnel, preferably of glass, is then inverted to cover the mouth of the jar, and the rising steam is inhaled through the nostrils as it escapes from the small end of the funnel. So used, especially during the evening, for a half hour, it conduces to a comfortable night's rest and facilitates recovery.

II. Simple Chronic Rhinitis and Purulent Rhinitis.

Recurrent attacks of acute rhinitis establish, in children and young people especially, a chronic inflammation of the mucous membrane, which is characterized by variable degrees of proliferation of the epithelium, and by muco-purulent secretion, which is often profuse. The disease is not accompanied by material enlargement of the turbinated bodies or distention of the erectile tissues, and stenosis is not a prominent symptom; which differentiates it from hypertrophic rhinitis.

Etiology.—Bosworth plausibly contends that children are particularly prone to inflammation of the epithelial lining of mucous membranes, and that the epithelial proliferation of muco-lymphoid glands becoming organized without desquamation accounts for enlargement of the tonsils, etc., while an allied inflammation in the nose, with rapid desquamation of the epithelium, constitutes the most important element in purulent rhinitis. The disease bears no constant relationship to scrofula, tuberculosis, or syphilis, since it affects children who are otherwise robust quite as frequently as it does the subjects of these dyscrasiæ. Inattention to hygienic matters, leading to frequent attacks of acute rhinitis, and failure to treat the same effectively, are potential factors in the establishment of this form of catarrh.

Symptoms.—A profuse muco-purulent discharge from both nostrils, swelling and redness of the external nasal appendage, and excoriation, with incrustation of the anterior nares, are the chief manifestations, a too profuse discharge being the sole complaint in the milder cases.

In the course of years, if the purulent type of rhinitis be not arrested, the mucous glands atrophy, the secretion grows less but thicker, and tends to accumulate in crusts. In other words, the disease passes gradually into the atrophic form of rhinitis, which is the successor to purulent rhinitis perhaps more frequently than to hypertrophic rhinitis, although commonly credited to the latter disease.

On the other hand, if simple chronic rhinitis does not assume the purulent type, it is prone to pass gradually into hypertrophic rhinitis.

Diagnosis.—Hypertrophic rhinitis is accompanied by more nasal obstruction and less secretion, although it is sometimes difficult to draw the line between these two affections, however distinct one type may be from the other; indeed, in rare instances the two pathological processes are seemingly associated. Hereditary syphilitic rhinitis can be excluded by rhinoscopic examination, and the purulent discharge occasioned by a foreign body in the nose is commonly unilateral, and the object can be discovered by the probe.

Treatment.—The first indication and most important point in the treatment of purulent rhinitis is to maintain absolute cleanliness of the nostrils. Muco-pus must not be permitted to accumulate and decompose in the sinuosities around the turbinated bodies, thus perpetuating the disease. In not too inveterate cases thorough cleansing by means of an antiseptic alkaline and mildly astringent spray, used three or four times daily with a hand-ball atomizer, is all that is necessary to effect a cure. The following modification of Dobell's solution answers this purpose admirably:

℞. Sodii boratis . . . . . gr. xv.
Sodii bicarbonatis . . . . . gr. xv.
Ol. eucalypti . . . . . ♏j.
Ol. gaultheriæ . . . . . ♏j.
Thymol . . . . . gr. j.
Menthol . . . . . gr. ss.
Glycerini . . . . . f℥ss.
Aquæ . . . . . q. s. ad f℥j.—M.

Sig. Dilute, adding two teaspoonfuls to one ounce of warm water for use as a spray.

The patient should be directed to use the spray several times at intervals of five minutes, especially during the morning and evening toilet, and to cleanse the nose by "blowing" in each interval.

If a more active astringent is necessary to check the hypersecretion, sulpho-carbolate of zinc, two to five grains to the ounce, may be used as a spray following the cleansing solution. In young children, who are terrified by spraying, these solutions, well warmed, can be used by means of a small syringe.

Where the purulent type of the disease is complicated by the presence of hypertrophies of the turbinated bodies, deformity of the septum, adenoid vegetations, etc., any of which obstructions will impair the drainage and cause a muco-purulent discharge, surgical treatment appropriate to this special cause or complication is usually indicated. However, the case should not then be regarded, strictly speaking, as one of simple rhinitis.

III. Hypertrophic Rhinitis.

This is a chronic inflammation of the mucous and submucous tissues of the nose, characterized by enlargement, especially of the turbinated bodies, which encroach upon the normal lumen of the nostrils and cause impairment of nasal respiration and drainage. The disease is stated to be rare with children, especially under ten or twelve years of age, but we are convinced that a mild form, or early stage, of the affection is very common at all ages.

Pathology.—Advanced hypertrophic rhinitis is characterized by enlargement and proliferation of all the elements which compose the turbinated bodies: the epithelial surface is thickened; the adenoid layer, which lies between the epithelial and submucous layers, is wider, and the lymph-corpuscles and fibrous connective-tissue bundles are more numerous; the acinous mucous glands are increased in number and size. The submucosa, which is composed largely of blood-vessels of a venous character—sometimes called a venous plexus—is particularly affected, the vessels being enlarged, more numerous, their walls thickened, and the intervascular connective tissue proliferated. The blood-vessels are more or less continually congested, causing "erection" of its structures, and they are no longer capable of complete "retraction" under favorable

influences or under the action of cocaine, but shrink only moderately or but little.

As Bosworth truly remarks: "These are changes which can only ensue during the lapse of years;" and to this extent we would not, therefore, expect to encounter them in children. However, in children and adolescents persistent enlargements of the turbinated bodies can and do present themselves in consequence of mere dilatation and engorgement of the vessels of the submucosa, without any considerable degree of cell-proliferation. Complete retraction in this form is possible, either spontaneously on one or both sides at intervals, or by means of cocaine, the mucous membrane shrinking close to the bony base.

This condition is occasionally referred to as a vaso-motor paresis, permitting over-distention of the vessels of the turbinated bodies and other parts affected; or, again, it is designated by Ingals as a distinct affection under the name of "intumescent rhinitis." But I am disposed to view it simply as an early stage, or, at most, a variety of hypertrophic rhinitis, for cases which present each degree of gradation between this and the advanced stage of the disease above described are continually encountered.

In addition to the intumescent type, even somewhat advanced grades of hypertrophic rhinitis are certainly met with in children.

Etiology.—The most prolific source of hypertrophic rhinitis in young children is adenoid vegetations, which by partial occlusion of the posterior choanæ interfere with the proper drainage and evaporation of nasal secretions, the irritation of retained and decomposing secretions serving to excite proliferative changes in the nose. It would seem, also, that the same dyscrasia—lymphatism, which predisposes certain children to hypertrophy of the tonsils and to naso-pharyngeal adenoid hypertrophy—favors the development of hypertrophic rhinitis. Clinically, these conditions are frequently conjoined, and it is certain that they sustain some dependence upon each other, for removal of the "adenoids" is often followed by subsidence of the nasal hypertrophies.

Recurrent acute rhinitis is another potent factor in the development of hypertrophic rhinitis, and, therefore, whatever serves to excite acute rhinitis must be accorded etiological consideration in reference to hypertrophic rhinitis.

Symptoms.—Nasal stenosis, or obstruction on one or both sides, is the most prominent symptom, together with many indirect effects due to the stenosis. As a rule, one side of the nose is stopped at a time, the two sides alternating in this respect, sometimes changing with great rapidity and without apparent cause. Again, absolute stoppage of one or both nostrils may manifest itself only under certain conditions, as during railroad travel or otherwise from inhalation of dust, from superheated apartments, and from exposure to a cold, damp atmosphere—conditions which necessarily arise so commonly as to cause much annoyance to the patient.

The secondary results of nasal stenosis are a nervous restlessness, which is excited in many by the sense of obstruction and pressure in the nose, inability to sleep soundly at night or intellectually to apply themselves persistently by day, together with headache and reflex pressure symptoms, such as hemicrania, or nervous sick headache, asthma, spasm of the glottis, and even epileptoid seizures. The most frequent of the reflex nasal symptoms in childhood are asthma in association with bronchitis, and spasm of the glottis in association with laryngitis; in fact, so common, in childhood, is dependence, at least in part, of chronic bronchitis with asthmatic symptoms upon nasal stenosis and adenoid vegetations that the closest scrutiny and attention should be given to the upper respiratory tract in all such cases.

Plethora of the blood-vessels of the nasal mucous membrane tends to develop

a like plethora in the bronchial mucous membrane, and anæmia induced in the turbinated tissues tends to effect an anæmic state of the bronchial tubes. The physiological relationship between the two regions—the nasal erectile tissues being designed to warm and moisten the inspired air—demands, through the vaso-motor system, an intimate correspondence between their blood-supplies. As might therefore be expected, a pathological correspondence also obtains, and, without entering into a discussion of the hypothetical details of nervous mechanisms, we simply state the oft-observed fact, that turgescence and vaso-motor paresis of the nasal erectile tissues may occasion vaso-dilation, congestion, and inflammation of the bronchial mucous membrane.

The term "reflex" is doubtless often misappropriated, yet it has a definite significance, and the pathological reflexes which originate in nasal or naso-pharyngeal irritation, and terminate in cough, laryngeal spasm, or asthma, follow much the same pathway as the physiological reflex known as sneezing. The nasal branches of the ophthalmic division of the fifth nerve and the nasal branches of the anterior palatine, descending from Meckel's ganglion, which is in connection with the superior maxillary division of the fifth nerve, conduct the sensory impression to the medulla. It is there reflected to the respiratory, pneumogastric, and other centres, whence the deep inspiration, forced expiration, and the coincident spasm of the pharyngeal and laryngeal muscles, termed a sneeze. This mechanism, of course, varies somewhat with the different pathological reflex acts.

But nasal irritation does not in every case result in reflex phenomena. Evidently, still other conditions are essential, which must be sought in functional derangement tending toward special susceptibility of certain nerve-centres, including those wrought upon by peripheral nasal irritation; and in chronic inflammation or a predisposition to acute congestive states of particular organs, which unquestionably favors the development in that organ of the ultimate link in the reflex chain. Thus, one affected with bronchitis would suffer the more readily from asthma, excited reflexly by nasal irritation; laryngitis predisposes under like conditions to spasm of the glottis, and digestive derangements to migraine. So, in the completed cycle, three factors obtain—nasal-irritation, superexcitable nerve-centres, and a susceptive peripheral organ. But the nasal irritation is the initial link without which the peculiar reflex is not excited, and to which the other factors are subservient.

Another symptom of hypertrophic rhinitis, secondary to this stenosis, is compulsory mouth-breathing with its many deplorable consequences—*e. g.* drying out of the mouth and pharynx, facial deformity, and mental obtundity—a symptomatic sequence which has been sufficiently elaborated in the article on "Naso-pharyngeal Adenoid Hypertrophy."

Also, concerning secondary impairment of hearing, what is said in that article pertains equally to this disease.

A very annoying symptom, and one which may first attract attention, is dysphonia; in fact, such children are constantly declared to be tongue-tied and the lingual frænum cut without benefit, when the real defect in speech lies in occlusion of the nares or naso-pharynx.

Diagnosis.—This is established by direct rhinoscopic examination anteriorly and posteriorly; the latter, however, is not always possible with young children. The turbinated bodies appear red, turgid, and swollen, but they occupy their natural positions and maintain their normal relations to each other and to surrounding parts; by which fact this disease can readily be distinguished from nasal polypus. A polypus occupies one of the spaces beneath,

between, or beside the turbinated bodies; it is, moreover, movable, and is of paler color than the inflamed mucous membrane.

Treatment.—When dependent upon adenoid vegetations, the surgical removal of these growths in children usually results in subsidence of the hypertrophic rhinitis. Resolution will be favored in these cases, however, as well as in the milder forms of the disease not secondary to naso-pharyngeal adenoid hypertrophy, by the use twice daily of an antiseptic, alkaline, and mildly astringent spray or lotion, formulated as prescribed in the section on "Simple Chronic Rhinitis." This is especially important as a cleansing measure in cases in which some degree of hypertrophy is conjoined with the suppurative type of rhinitis. Refined petroleum products, variously known as "albolene," lavolene, benzoinol, etc., are just now extensively employed in many combinations in all forms of rhinitis, but antiseptic, alkaline, aqueous solutions are certainly more effective when the parts are to be cleansed of muco-purulent accumulations. Petroleum sprays are, however, often soothing and protective to the parts, especially at times of acute and subacute exacerbations, and may be used in such cases following the aqueous spray twice daily, or used alone with patients who have no retained muco-purulent secretions. "Vaselin oil," being more viscid than the whiter products, and yet sufficiently fluid to be converted into spray by a good double-bulb hand-atomizer, is best adapted to this use, and may be prescribed in the following combination:

℞. Ol. pini Canadensis . . . . . ♏v.
Ol. gaultheriæ . . . . . ♏ij.
Ol. eucalypti . . . . . ♏ij.
Thymol . . . . . gr. ss.
Menthol . . . . . gr. j.
"Vaselin oil" . . . . . q. s. ad f℥j.—M.
Sig. Use with a double-bulb atomizer.

A more astringent spray is occasionally beneficial, although strong astringents are not well borne by the nasal mucous membrane:

℞. Zinci sulphocarbolatis . . . . . gr. v.
Iodi . . . . . gr. j.
Potassii iodidi . . . . . gr. ij.
Menthol . . . . . gr. j.
Ol. gaultheriæ . . . . . ♏iij.
Glycerini . . . . . f℥j.
Aquæ . . . . . q. s. ad f℥j.—M.
Sig. Use with atomizer.[1]

Persistent use of these remedies, together with the surgical removal of adenoid vegetations and enlarged faucial tonsils, and hygienic guards to prevent frequent "colds," will effect a recovery in the majority of cases of hypertrophic rhinitis of children. A minority, however—which includes, especially, the older children—will not yield to this treatment, and will require reduction of the hypertrophy by means of the electro-cautery in order to overcome the nasal stenosis. One should not hesitate to adopt this method in suitable subjects, for the results are very satisfactory and the disadvantages trivial; but considerable technical skill is necessary to ensure entire safety; consequently it should not be attempted by one who is unfamiliar with intranasal operating.

[1] "Vaselin oil" or albolene can be substituted for the glycerin and water in this formula.

Five per cent. cocaine solution on cotton is first placed in contact with the whole length of the inferior turbinated body for ten minutes. The knife electrode is commonly used, but we prefer, as better adapted to the purpose, the ordinary point electrode, which we curve slightly upon the flat, using the surface of the platinum end, and not the very point, with which to burn. This makes a broader eschar than the knife electrode, it is less apt to occasion hæmorrhage, it requires less space in transit through the nostrils, and it adapts itself better to the curved contour of the turbinated body, permitting application farther toward the posterior end of that body.

The cocaine retracts the erectile structures and temporarily provides space through which the unheated electrode is passed: the length of the platinum tip is pressed against the turbinated body, commencing as far posteriorly as one can see, and then, when at white heat from the battery, it is drawn slowly forward, marking its passage by the production of a white linear eschar. Through this same linear eschar, in order to deepen it, one now draws the instrument a second and a third time. Many will direct that the electrode be employed at a cherry-red heat, but during use the point is sunk in a moist tissue, and what is a white heat in the atmosphere is no more than a cherry heat when in contact with the moisture of the turbinated body.

The two nostrils should never be treated at the same sitting, and more than one linear cauterization should not be made at one time, although it may be well to draw the electrode two or three times along the same track in order to obtain sufficient depth, as the subsequent cicatrix, in addition to breaking up the free continuity of blood-vessels and substituting a certain overplus of tissue, should serve also to bind down the neighboring portions by attachment to the bony base. Bad cases require six to eight applications of the cautery at intervals of one to two weeks, two or three on each lower turbinated body, and others of less extent on the middle bodies. Antiseptic cleansing sprays should be used during the intervals. Moderate sepsis has followed this operative treatment in a few instances: consequently it is best to see the patient on the second and fourth day after operating for the purpose of effecting absolute cleanliness.

The best substitute for the galvano-cautery when this is not available is chromic acid, which may be used by fusing a bead on the end of a probe and applying it much as one would the electrode. It is apt to produce excessive breadth and insufficient depth of eschar.

IV. Atrophic Rhinitis.

This disease, termed also dry catarrh, ozæna, and fetid rhinitis, is characterized by atrophy of the mucous membrane, of the underlying cavernous structures, and of the bony projections within the nose, which leads to increased spaciousness of the nostrils: also by atrophy with impairment of function of the mucous glands, by reason of which the muco-purulent secretion becomes inspissated and accumulates in the form of crusts, which, in turn, undergo decomposition and occasion fetor.

Etiology.—Fränkel first promulgated the theory that atrophic rhinitis was a sequel to hypertrophic rhinitis, a late stage of that disease; and his views have seemingly been adopted by most other writers, a few guarding this dictum by stating that this disease can also arise independently.

In a discussion before the American Laryngological Association in 1891, I made this statement: "With regard to the transition of hypertrophic rhinitis into atrophic rhinitis, ... I have never seen a case in which distinct hypertrophy had passed, definitely, into the atrophic condition."

The life-histories of the two affections are dissimilar. Atrophic rhinitis is common in childhood and early adult life, becomes rare after thirty-five years of age, and is very infrequently observed in patients exceeding forty years of age.

Hypertrophic rhinitis of the early intumescent variety is not uncommon in childhood and early adult life, but the disease does not become firmly established, with permanently organized infiltration of the turbinated bodies, at least until maturity; and in the vast majority of cases the quantity and density of infiltrated tissue continues to increase until advanced age.

Since it is conceded that about ten years' duration of the hypertrophic type is usual before transition into the atrophic type, it is apparent that this theory leaves us without an adequate explanation of the many cases of atrophic rhinitis which occur in early life.

The few cases which are explicitly reported by competent observers as having undergone this transition were doubtless illustrations of coincidence, in which, notwithstanding the previous existence of hypertrophy, some other unnoticed or obscure intercurrent cause had served to effect the atrophic change. Bosworth has advanced the most rational explanation of the etiology of atrophic rhinitis in designating "suppurative rhinitis of children" as the real cause—a view which harmonizes with the life-history of the disease, and which is consistent with the undoubted occurrence of the coincidence above mentioned; for it is possible for one already the subject of hypertrophic rhinitis to acquire, in addition, the suppurative type of rhinitis, which latter may terminate in the atrophic state in spite of the previously existing hypertrophy.

Bosworth's theory, moreover, is of special value from a prophylactic standpoint, since it teaches us the importance of promptly suppressing chronic suppurative rhinitis, viewed as a cause the ultimate effect of which, atrophic rhinitis, is, itself, difficult of suppression.

Bosworth says, in brief, that the predominating morbid condition of purulent rhinitis is desquamation of epithelium: that as long as this desquamation is confined to the superficial epithelial cells the disease is attended with a thin and fluid muco-purulent discharge, but that, sooner or later, the desquamative process extends to the epithelial lining of the muciparous and follicular glands; the glandular function is then impaired, and the muco-purulent discharge becomes thick and firmly adherent, in the form of crusts and scales, to the sinuosities of the nose. Further, that this film of desiccated muco-pus, in drying, contracts, and embraces the underlying turbinated tissues in a grasp which necessarily must interfere with the circulation of blood—a condition which limits glandular action still more and conduces to general atrophy.

Hereditary predisposition to atrophic rhinitis is often pronounced. For instance, a patient, aged twenty-two, has developed the disease during the last two years: her mother, for some years deceased, suffered from the disease in a typical form: the patient's child, aged three years, is likewise affected.

Pathology.—The prominent features of the atrophic process are thus summarized by Bosworth: "*First.*—Decrease of covering epithelium, with profuse desquamation. *Second.*—Decrease of the adenoid layer, with lack of blood-vessels, together with destruction of the acinous glands. *Third.*—A total disappearance of the venous sinuses of the submucous layer of the membrane."

Symptoms.—Crust-formation and fetor are the most prominent symptoms of the disease, although other secondary manifestations are numerous.

The crusts may accumulate only in thin scales or in large masses of horny consistency, which may even occlude the nostrils at times, being firmly

adherent and impacted in the sinuosities of the bones, until by decomposition and softening of the layer adjoining the mucosa they are finally cast loose and expelled in large pieces by blowing, often leaving abraded surfaces behind.

The fetor varies in intensity in different cases, but is rarely entirely absent, and in its severe forms is so horribly nauseating and penetrating as to contaminate the atmosphere of an entire room in a few minutes, and to necessitate comparative isolation of the patient. The fetid odor is apparently due solely to decomposition of the incrusting secretion *in situ*, but there is reason to believe that this decomposition may extend to the secretion which is still in process of elaboration in the substance of the glands themselves, although this is difficult of absolute demonstration: for, however thoroughly one may cleanse the parts, fetor, persisting, might still be caused by small invisible particles of crust in the accessory cavities, ethmoid cells, or sphenoid sinuses.

In advanced cases, commonly, the sense of hearing is impaired, the patient's own sense of smell obtunded, the external nose broadened, its alæ thickened, and the physiognomy lacking in acuteness of expression.

The disease extends after a time to adjoining surfaces, constituting atrophic naso-pharyngitis and atrophic pharyngitis. The naso-pharynx becomes so incrusted that the fetid masses must be literally pried out with probes and forceps. The pharynx presents a capacious, glazed, and dry aspect characteristic of the disease. Much more rarely even the larynx and trachea become involved, crusts accumulating in these passages to the point of occasioning dyspnœa.

Diagnosis.—On rhinoscopic examination, both anteriorly and posteriorly, one is impressed by the spaciousness of the nasal cavities and the presence of scales or crusts. After thorough cleansing the mucous membrane appears smooth and thin, although oftentimes congested and abraded in spots from the irritation of long-retained incrustation. In advanced cases the turbinated bodies appear merely as rudiments.

The disease is likely to be confounded, especially in childhood, with hereditary syphilitic rhinitis, which is also accompanied by fetor and incrustation. Unfortunately, by reason of the fetor the term "ozæna" has been applied to both diseases; consequently it is a bad name for either affection, especially since it refers only to the symptom fetor.

In atrophic rhinitis there is uniform atrophy and incrustation without deep destructive ulceration. In syphilitic rhinitis the atrophic process, if present at all, is not uniformly distributed, the nostrils being contorted by deep ulceration and destruction, with subsequent cicatrization, of various parts. Reference may be made to the section on hereditary syphilis of the nose for additional details.

Prognosis.—Atrophic rhinitis requires persistent thorough treatment over a period of from four months to two years, in order to effect recovery even in young subjects and in recent cases. Both patient and physician are prone to become discouraged and to abandon treatment, much to the disadvantage of the former. Old, inveterate cases must continue cleansing measures for years, as part of the toilet, with the same regularity that is given to the teeth. In the worst cases the difference between persistent treatment and total inattention is the difference between the lot of an acceptable member of society and that of a social outcast.

The fact that the disease is rarely observed at an age of over thirty-five to forty years argues a natural predisposition to recovery as life progresses, and should operate as a further incentive to persistent treatment.

Treatment.—The first essential to successful treatment is absolute and continuous cleanliness of the parts. The crusts must not be allowed to form, much less to undergo decomposition. One of the most efficient means to this end, especially for young children, is the nasal douche. I believe it to be justifiable, for the sake of efficient treatment of this particular disease, to assume the slight risk of inflammation of the ear possible by this instrument. This risk, with proper use of the instrument, is remote in comparison with the danger to the same organ from atrophic rhinitis inefficiently cleansed. The original instrument of Thudicum was of glass, but the ordinary soft-rubber bag gravity douche, fitted with a nasal nozzle (Fig. 1), answers the purpose still better. It should be suspended from a nail over a convenient basin at such a moderate height that the bottom of the bag is only about three inches above the level of the nose as the head is held over the basin. The patient must maintain breathing by the mouth, well opened: when on applying the nozzle to one nostril the liquid will gravitate gently and slowly into one nasal passage and out through the other, the oral respiration sufficing to close the naso-pharynx from the oro-pharynx by the velum palati. Not force, but thorough maceration, is requisite to detach the crusts; therefore one to two pints of fluid should be gently and slowly used twice daily as a part of the morning and evening toilet. The liquid employed should be *alkaline*, to facilitate solution of the crusts; *antiseptic*, to counteract the fetor; and *stimulating*, to encourage regeneration of the atrophied glands. These qualities are provided in the following formula:

Fig. 1.



Anterior Nasal Douche and Method of Using it.

℞. Sodii bicarbonatis . . . . . ʒiij.
Sodii boratis . . . . . ʒiij.
Extracti pini Canadensis fluidi . . . fʒj.
Glycerini . . . . . fʒiv.
Aquæ . . . . . q. s. ad fʒviij.—M.
Sig. To be diluted according to tolerance, adding one ounce to the pint or quart of warm water for use with the nasal douche.

With older children, who can be taught the necessary manipulation, Warner's post-nasal douche (Fig. 2) should be substituted for the anterior douche of Thudicum, on account of greater safety relative to the ear. The same solution in the same proportion can be used with it. One must first draw up a part of the liquid through the instrument into the rubber ball; then insert the curved nozzle through the mouth, behind the velum palati, into the naso-pharynx, and squeeze the ball, thus expelling its contents forward through the nasal passages. This procedure should be repeated until half a pint of liquid is thus used morning and evening. Children who will not tolerate either of these means can conveniently have the nostrils syringed by an ordinary soft-rubber-tipped ear-syringe.

Peroxide of hydrogen has the property, by rapid oxidation, of disin-

tegrating muco-purulent matter, and, when sprayed into the nostrils, it will thus assist materially in loosening the desiccated secretion. It should be used a few minutes before the employment of either form of douche, of a strength just insufficient to cause smarting, sprayed by a powerful double-bulb hand-atomizer. On account of variability and instability of the drug, an exact strength cannot be named, but a 20 to 40 per cent. solution of a 10- to 15-volume peroxide of hydrogen is suitable.

Fig. 2.



Post-nasal Douche.

The patient should receive treatment, preferably, from one to three times weekly in the office, at which time any resisting crusts should be detached by a cotton probang, and more actively stimulating and antiseptic medicaments applied. Of these, the powder insufflation of dithymol iodide (aristol) is one of the most satisfactory.

For the excoriation and incrustation around the anterior nares and over the cartilaginous septum, which is often one of the most annoying features with children, the following ointment, thoroughly used each night, being inserted into the nostrils as far as the finger will reach, gives the most satisfactory results:

R. Hydrargyri oxidi flavi . . . . . gr. j.
"Vaselin" . . . . . ℥j.—M.
Sig. For local application.

Sprays of "liquid vaselin," with which antiseptic and stimulating medicaments, such as thymol and menthol, may be incorporated, are also serviceable at times, tending to retard crust-formation.

Of extraordinary measures, electricity is advocated by Delavan of New York, and "vibratory massage" by Braun of Trieste.

Cod-liver oil and syrup of iodide of iron are seemingly the most useful internal remedies, although neither can be relied upon to the exclusion of local treatment.

V. Nasal Myxomata.

Nasal myxomata, or mucous polypi, are connective-tissue neoplasms which originate from the mucous and submucous tissues of the nose. The disease does not exist as a primary affection—a dictum which is more emphatically, albeit less elegantly, expressed by stating that polyps will not grow in healthy noses. They are always associated with, and caused by, some other nasal malady. Indeed, the removal of such associated maladies together with the polypi is the "keynote" to the proper and effective handling of the patient.

Polyps are stated to be rare with children, but are probably only relatively so, since the diseases which influence their development are somewhat less usual in young children than in adults. We have observed them in children from the age of eight years upward.

Recognition of the exact points of origin of the neoplasms is essential to a clear understanding of their etiology and treatment.

In the outer wall of the middle meatus of the nose is the ethmoidal fissure, or *hiatus semilunaris*, the antero-inferior boundary of which is a sharp-edged ridge of hook-like curve, and hence termed the unciform process of the ethmoid

bone (Fig. 3). The fissure itself communicates through its upper end with the frontal sinus, and through its lower extremity, the ostium maxillare, with the antrum of Highmore. All of these parts lie high up beneath the middle

FIG. 3.



Representing the Outer Wall of the Left Nasal Fossa, with the middle turbinated body turned upward to show beneath the hiatus semilunaris (printed in deep black), to the edges of which polyps are frequently attached.

turbinated bone, which, in the natural state, hangs down over them like a curtain.

To summarize Zucherhandl's post-mortem observations of forty-two distinct growths, he found that *two-thirds* originated from the middle meatus, and that, approximately, *two-thirds* of this number were attached to the edges of the hiatus semilunaris. With this knowledge, and judging from the superficial position of the neoplasm and the direction of its pedicle toward its attachment, we can be reasonably certain of the deep point of origin even when such is not visible, and can often destroy the very root of the growth by insinuating a properly-curved cautery point-electrode to the spot.

Etiology.—The most common complication, acting also in a causal relation to nasal polypus, is hypertrophic rhinitis. Of course, additional factors are necessary to influence the perversion of a simple hyperplasia of the mucosa into one of myxomatous type.

Stenosis, whether induced by hypertrophy of the inferior turbinated bodies,

septal deflections, or excrescences, results in defective drainage. Muco-purulent secretion, imprisoned and decomposing in the middle meatus and around the middle turbinated body, excites irritation and furnishes the most favorable soil for polyp growth.

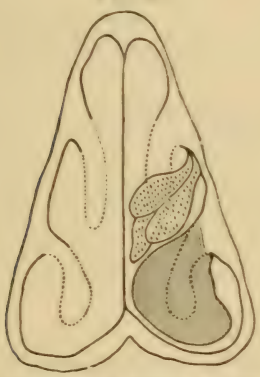
Very narrow nostrils, because more readily stenosed, are predisposed, in this manner, to myxomata, and peculiar curvatures or deformities of the septum and middle turbinated bodies, by obstructing drainage, have a like effect.

A tendency to vaso-motor paresis of a diathetic or hereditary nature, which, in certain subjects constitutes the basic lesion of bronchial asthma, will in the same individual underlie the development of nasal myxomata.

The influence of hypertrophic rhinitis on the etiology and treatment is well illustrated in the following history:

Miss T——, æt. ten years. Total obstruction of the left nostril of one year's duration. Enormous hypertrophy of the inferior turbinated bodies. Numerous polypi were closely impacted between the turbinated bodies and the septum; they proceeded from the middle meatus, and were continuously imbedded in a mass of thick, viscid muco-purulent secretion (Figs. 4 and 5). The

FIG. 4.



Polypi in the Middle Meatus, caused by hypertrophy of the inferior turbinated body (child aged ten years).

FIG. 5.



Lateral View of the Same (Fig. 4).

polypi seemed secondary to the hypertropic rhinitis and defective drainage. On the right side hypertrophy was present, but was insufficient to obstruct the drainage, and no polypi were visible.

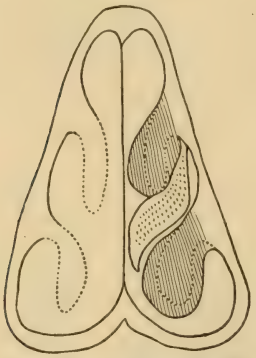
Operations first by the cold wire snare resulted in the removal of numerous growths during repeated sittings, but without improvement. The polypi developed as rapidly as removed, springing up like mushrooms in the soggy soil maintained by the imprisoned secretions. The inferior turbinated body was next cauterized along its entire extent, being reduced in front almost to a rudiment, where it previously interfered with vision, instrumental passage, and drainage. One was enabled then to trace the tumors to their exact seat of attachment in the immediate vicinity of the hiatus semilunaris, and to thoroughly eradicate them by reaching that position with a cautery point. No recurrence. Cure complete.

Again, Miss R——, aet. twelve years. Has had catarrhal symptoms for some years, with adenoid vegetations and obstruction to the left nostril. Examination Feb., 1893. A single polypus proceeds from the left middle meatus, and is traceable in the direction of the hiatus semilunaris, to which it is evi-

dently attached (Fig. 6). The inferior and middle turbinated bodies are hypertrophied, and obstruct drainage from the middle meatus.

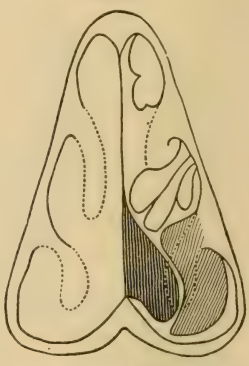
In Fig. 7, taken from an older subject, is depicted the manner in which a septal excrescence, by serving as an obstruction to respiration and drainage,

Fig. 6.



Single Polypus in the Middle Meatus, caused by hypertrophic rhinitis (child aet. 12).

Fig. 7.

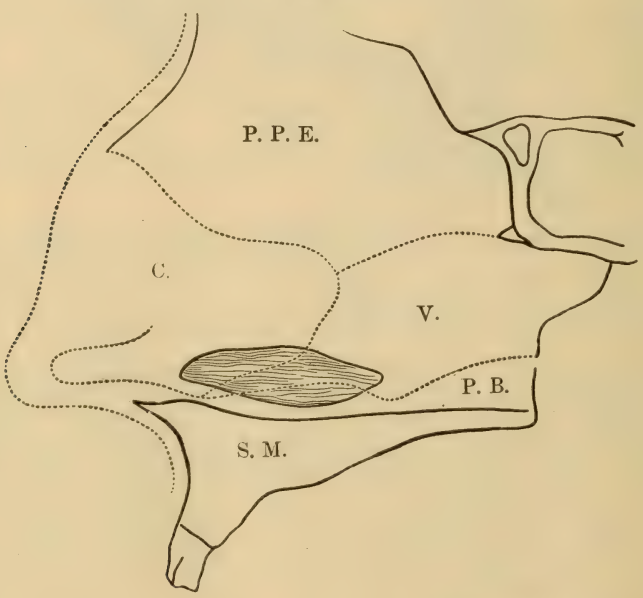


Polypus in the Middle Meatus, associated with hypertrophy of the inferior turbinated body and excrescence of the septum.

especially when conjoined with hypertrophy of the opposite turbinated body, as illustrated, may dam up the secretions in the middle meatus and encourage the growth of polyps.

Septal excrescence often originates during the developing period of child-

Fig. 8.



hood, and is a deformity of the septum narium characterized by an exuberant and projecting growth of bone and cartilage along the sutural lines of the component bones and cartilages of the septum narium. The most frequent location

is the sutural line of the vomer and the superior maxilla and cartilaginous septum just within the anterior nares and close to the floor of the nose (Fig. 8).

Necrosing ethmoiditis of Woakes also figures as a persistent cause and complication of nasal polypus. It involves the nasal tributaries of the ethmoid bone, especially its process, the middle turbinated body, which usually appears cleft asunder, leaving a fissure down its centre, from which will protrude the polypi. This is illustrated in Fig. 9, which was taken from a patient, aged twenty years, who had suffered since childhood.

Empyema of the antrum of Highmore, although rare with children, is also a prolific source of nasal polypus in adults, apparently caused by the constant presence of fetid pus in the middle meatus as it escapes from the antrum through the hiatus semilunaris.

FIG. 9.



The form, aspect, and consistence of a myxoma has been compared to a grape-pulp. The natural shape is pyriform, but this is often varied by pressure. When small, it is sessile, but it becomes pedunculated by gravity as development proceeds, and the point where the pedicle is confounded with the tissues of attachment is known as the "root." The color varies according to vascularization from gray to yellow and from yellow to pink and red.

Pathological Histology.—A typical myxoma, or "myxoma hyalinum," resembles in structure the vitreous body of the eye and the gelatin of Wharton of the umbilical cord. Microscopically, there are observed either a few roundish cells, as in the vitreous body, or scattered fusiform and stellate cells which send off anastomosing trabeculæ, as in Wharton's gelatin, or both together, and these are imbedded in a large quantity of a homogeneous gelatinous mucin containing intercellular substance.

But myxomata rarely appear in this purely typical form, the "myxoma hyalinum" being prone to transformation into allied histological structures or to be represented from the beginning by one of its modified forms. Of these, the most common is the myxo-fibroma, which contains a greater but variable quantity of fibrous tissue. Those which are ordinarily called myxomata usually contain enough of the fibrous element to include them, strictly speaking, within the class of myxo-fibromata.

Symptoms.—The chief symptom is nasal stenosis, which increases with the development in size and number of the polypi until complete obstruction of one or both nostrils results. Mucous or muco-purulent discharge, cephalalgia, aural complications, and other symptoms of a catarrhal nature, together with those incident to mouth-breathing, are observed. To quote the words of a sufferer: "It affects the sight, the hearing, the taste, and the smell, of course." Spasmodic asthma, paroxysmal cough, and sneezing attacks are among the reflex phenomena which are occasionally excited.

Diagnosis.—For diagnostic purposes it is usually only necessary to look with a good light and to feel with a probe in order to establish correspondence with the physical characters just described, but more rarely an accurate knowledge of all pathological states is essential to a precise diagnosis.

Treatment.—The treatment consists first in the establishment of free nasal passage for respiration, drainage, vision, and instrumental manipulation, and, to this end, in the reduction of hypertrophied turbinated bodies, and removal when

necessary of septal excrescences by means of the nasal saw. Adenoid vegetations, if present, should be removed.

While this work is progressing such polypi as can be reached should be removed, and others as rapidly as access is gained. This is done preferably by the cold wire snare.

But the real success of the treatment, after having gained access to the polypi, consists in tracing them to their points of attachment, and in thoroughly cauterizing these so-called roots; if not at the same sitting, then at the next, remembering meanwhile the exact spot. Knowing the hiatus semilunaris to be a favorite point of origin, those polypi which proceed from beneath the middle turbinated body should be followed up by insinuating to this point a fine electrode slightly curved on the flat.

The permanent success of the treatment will depend upon the possibility, in individual cases, of thus reaching the deep points of origin, and upon the establishment of good drainage in the nose.

VI. Hereditary Syphilis of the Nose and Throat.

Hereditary syphilis manifests itself in children at any time from birth to four months of age. It has, of course, originated during intra-uterine life, and simply progresses to the point of becoming particularly apparent in the upper respiratory tract during the period stated. In rarer cases it seemingly thus manifests itself first at the age of puberty, or, indeed, at any time previous to this age, but in these cases it is doubtful whether the slighter symptoms at the earliest period of life have not simply been overlooked.

From birth onward the disease passes through stages which in their symptomatology and pathology are identical with the secondary and tertiary stages of acquired syphilis. Thus, soon after birth syphilitic rhinitis is manifested by coryza, which, as the disease progresses, gradually develops into a mucopurulent discharge, the acrid secretion causing excoriation and incrustation at the margins of the nostrils. It is probable that infiltration of the superficial layers of the mucosa by embryonic cells, and subsequent degeneration of the same into "mucous patches," also occur; but a satisfactory examination of the interior of the nose is impossible at this early age, and a definite diagnosis of this stage may be dependent upon the concomitant symptoms of syphilis. The disease, however, usually runs a rapid course, and the later manifestations, which correspond to the tertiary symptoms of the acquired form, are sufficiently characteristic. A gummatous infiltration, either diffused or circumscribed, occurs in the depths of the tissues, the entire thickness of the mucosa, the cartilages, and bones being alike subject to an infiltrating deposit of small round cells of embryonic type. These deposits readily undergo degeneration, and result in deep destructive ulceration of the tissues and cartilages and in necrosis of bones.

The disintegration may commence either in the centre or depths of the tissue or upon its surface, and is seemingly occasioned by the cutting off of the blood-supply to this lowly-vitalized material by pressure exerted in all directions by the cells themselves. The cartilaginous septum narium soon disappears, the vomer is attacked, the nasal bones affected, and the external nasal appendage sinks backward and downward, acquiring the "saddle-back" deformity or "flat nose." One or both alæ are not uncommonly destroyed, and subsequent cicatrization may obliterate the nasal orifices. In fact, there is no limit to the horrors of this disease when left unchecked, necrosis continuing until death is caused by hæmorrhage or meningitis.

In the throat favorite points of attack are the velum palati and the junction of the velum with the hard palate, as well as the palatal processes of the palate bone and of the superior maxillary bone. Thus, the cavities of the nose and mouth are caused to communicate by perforations of greater or less extent. The pillars of the fauces and the posterior pharyngeal wall are by no means exempt. The ulceration being deep, the following cicatrices must be extensive, and are found to be thick, dense, and prone to extreme degrees of contraction, so that they appear, oftentimes, stellated or twisted and contorted into various shapes. They are comparable to, but worse than, the cicatrices which follow deep burns. In this way the pharynx and velum become adherent, the throat being contorted and twisted apparently into one cicatricial mass, which may leave but a minute opening between the pharynx and naso-pharynx. Crusts accumulate in the nasal cavities, and the fetor is intense, occasioned both by the decomposing incrustations and necrosis of bone.

Treatment.—The patient should be placed as rapidly as possible under the influence of mercury, which is best done by inunction with mercurial ointment. In many cases mercury alone seems superior to the potassium iodide or the mixed treatment. Attention to the bowels and care of the general health are not to be omitted, nutritious diet, fresh air, and tonics being indicated.

The local treatment is of the utmost importance. The ulcers must be kept absolutely clean and free from decomposing discharges. The means to this end are the same as those detailed in connection with atrophic rhinitis. As a topical application to the ulcers we value most highly the following solution:

℞. Iodi, ...
Acidi tannici, ...
Potassii iodidi . . . . . *āā* ʒj.
Glycerini . . . . . fʒss.
Aquæ . . . . . q. s. ad fʒj.—M.
Sig. Apply by a cotton swab.

Under this treatment it is a veritable pleasure to watch the absorption of infiltrated masses and the cicatrization of the ulcers.

CATARRHAL LARYNGITIS (SPASMODIC CROUP).

By H. ILLOWAY, M. D.,

Cincinnati.

Catarrhal Laryngitis, termed also spasmodic laryngitis, pseudo-croup (false croup), and acute laryngitis, is an acute inflammation of the mucous membrane lining the larynx, and not infrequently involves that of the trachea. The disease may present itself with varying intensity; clinically, three distinct forms have been recognized—the *mild*, the *severe*, and the *very grave*.

In addition to the usual symptoms we may have—and this is more especially true of the severe form—paroxysms of dyspnœa manifesting themselves, which by some are regarded as true laryngeal spasms. The catarrhal laryngitis with the paroxysms of dyspnœa superadded, which is frequently treated as a distinct disease, has been designated laryngitis stridulosa, angina stridulosa, and spasmodic laryngitis; it is also called pseudo-croup or false croup, to distinguish it from true croup or pseudo-membranous laryngitis.

Catarrhal laryngitis is a disease that occurs at all periods of child-life from birth up to the fifteenth year. Pseudo-croup is seen with greatest frequency between the second and fourth years. It is rarely seen before the second year, and still more rarely after the fifth year. It attacks children both strong and weak, and does not make much distinction between the children of the rich and those of the poor. It is said that boys are more prone to the disease than girls; there are, however, no sufficiently reliable statistics upon this point, as this disease has been confounded by many writers with laryngismus stridulus (spasm of the glottis), for which this statement holds good.

Catarrhal laryngitis presents itself either as an idiopathic affection or as a secondary and symptomatic one, and then usually in the course of some general disease. It occurs with greatest frequency in the colder months, about the beginning and end of winter. In certain latitudes, where the winters are rather mild and the snow melts very quickly and the streets are thus wet and slushy, it prevails throughout the whole winter. The sudden setting in of cold, wet days in summer may cause an outbreak of catarrhal laryngitis.

Etiology.—The principal etiological factor is taking cold. A very young child may contract a cold by sitting on a cold floor, by throwing off the coverlet at night after the temperature of the room has cooled considerably, by a sudden transference from a very warm to a cold room, more particularly a cold draughty hall, or by being taken out on a cold, windy, blustery day; older children take cold by going out insufficiently clothed, by taking off top-coats in the street after having become heated at play, by wading in water or in snow. Cold air inspired directly, and especially whilst the vocal organs are violently exercised, as in screaming or yelling, is not an infrequent cause of laryngeal catarrh. In some instances I have attributed attacks of pseudo-croup to the cold, moist atmosphere created in the bed-room by a floor scrubbed late in the evening and not thoroughly dried before the child was put to bed.

In some children a predisposition to catarrhs of the upper air-passages undoubtedly exists as the result of a faulty physical training, faulty domiciliary hygiene, and perhaps improper diet in combination with some of the other factors. Scrofulous, weak, anæmic children, with proneness to coryza and to inflammatory affections of the tonsils, are more especially liable to attacks of pseudo-croup. A characteristic of this latter form of catarrhal laryngitis is the tendency to recurrence: children who have once had an attack of spasmodic laryngitis are liable to have a like attack after every, even very slight, exposure. After the fifth year, especially if placed under more favorable hygienic conditions, they soon outgrow this tendency; I have, however, observed instances where children have remained croupy as late as their ninth year. It is this affection which people really mean when they speak of their children having had three, four, or more attacks of croup.

Whilst catarrhal laryngitis may be of the mild or severe type from the onset, the grave form is always an acute progression, chiefly due to neglect, of one or the other milder form. The child is allowed to play around at its will despite hoarseness and cough, to expose itself to draughts, to get wetted by rain, till all at once the symptoms of the grave type manifest themselves. The majority of the cases of this character observed by me were due to premature exposure after an attack of measles, before the catarrhal laryngitis that usually accompanies that disease had fully subsided.

Laryngo-trachitis is frequently but part of a general inflammatory condition extending downward from the nose to the bronchi: more rarely it is due to the upward extension of a tracheo-bronchitis.

Occasionally it is due to the exciting influence of local irritants. The inhalation of hot steam, a very dusty atmosphere, and irritating vapors are not infrequent causes of catarrhal laryngitis. Baginsky reports a case where the prolonged inhalation of coal-gas produced a violent laryngo-trachitis.

As a symptomatic expression of a general affection catarrhal laryngitis occurs in measles, scarlet fever, variola, and erysipelas. It may appear as a complication in typhoid fever, in broncho-pneumonia, and in pulmonary phthisis.

Pathology.—The most reliable data concerning the coarser anatomical changes occurring in this disease have been obtained by laryngoscopic examination. The principal features of a catarrhal laryngitis are hyperæmia, swelling of the mucous membrane, and rather abundant muco-purulent secretion, somewhat viscid in character and found adhering to various sections of the laryngo-tracheal mucous membrane. Diffusion and intensity of the hyperæmia may vary greatly. The inflammation may be confined to the entrance of the larynx or to the epiglottis (angina epiglottidea); it may be more marked in the middle portion of the laryngeal cavity; it may attack only the vocal cords and the posterior commissure, or it may be diffused over the whole of the larynx. The color of the mucous membrane may range from that of a slight vascular injection to a deep dusky red. The vocal cords may present an almost normal appearance, their lustre perhaps somewhat dimmed; they may be more or less hyperæmic, or they may appear as two large rolls of deep red color by reason of marked swelling of their under surface. The tumefaction also varies in extent—sometimes so slight as just to prevent free movement of the vocal cords, at other times so great as to cause marked stenosis. The epithelium is exfoliated in patches, and shallow erosions there appear; in other parts it will be seen swollen up and forming grayish circumscribed elevations. Small ulcers are sometimes seen, the result of destruction of the epithelial covering and of bursting of distended muciparous follicles. The secretion is at first scant, and if the catarrh be of the mild form and remain limited to the vocal cords, may

continue so throughout the whole course of the disease. Usually it is at first viscid and transparent like glass; later on, by the addition of cell-detritus, it becomes turbid and yellowish gray.

In the severe forms of catarrhal inflammation of the larynx the epiglottis presents a characteristic change of form; the incurvation of its lateral borders, which to a certain extent is normal in childhood, becomes greater, and frequently gives it the appearance of a deep-red swollen stump, which can be seen even without a mirror by simply depressing the tongue.

In the trachea the vascular injection is rarely a diffused one; only in the more intense forms do we find the whole mucous membrane deep red and velvety. Ordinarily the redness is here found in patches; the tracheal rings can be readily recognized, and the mucous membrane covering them is less injected, paler than that of the interspaces.

In the grave form the inflammation frequently involves the submucous tissue.

For greater lucidity and better comprehension the various types will now be considered separately.

I. The Mild Form (Laryngitis Catarrhalis Simplex; Supraglottic Laryngitis).

Symptoms.—The main features of the disease are the change in the voice or cry and the cough. In young infants it is only the cry that is altered, whilst in older children the speaking voice is also changed; they are hoarse. This hoarseness may be very slight, only noticeable to those familiar with the child, or marked and apparent at once to every one. There is almost never aphonia; however, in infants who cry and scream a great deal aphonia may result from this. Older and more intelligent children may complain of a tickling or burning in the larynx or about the sternal region. Pressure over the cricoid cartilage or over the trachea usually produces manifestations of pain. There is not much cough; it is chiefly due to voluntary efforts at expulsion of mucus. The cough is dry at the outset, but very soon becomes looser and softer, an indication of the resolution of the catarrhal process. It never has the barking tone of the *severe* type. Respiration remains unchanged. There are no paroxysms of dyspnœa. Generally there is greater hoarseness and more cough in the morning just upon awakening and in the evening. Fever is most frequently wanting; when it does present itself, it is usually of slight degree. There is but little disturbance of the economy as a rule; the child eats, plays and sleeps about as usual. Acute rhinitis is almost always present; at times some redness and swelling of the pharyngeal mucous membrane may be noted. In some instances the child may complain of earache, which, however, very soon disappears, or he may complain of a "cracking" in the ear, heard in the act of swallowing. Occasionally some bronchial catarrh may be present, as indicated by râles heard over the thorax.

Laryngoscopic examination discloses a moderate hyperæmia of the larynx or a more intense hyperæmia of the larynx and trachea. In the majority of cases it is limited to the supraglottic portion of the larynx. The posterior portion of the vocal cords, the posterior commissure, and the mucous membrane of the ventricular bands are the principal seat of the catarrh. There is but very little or no swelling of the mucous membrane.

Course and Duration.—Under fair conditions the disease runs a very rapid and favorable course, ending in recovery. Its duration, dependent somewhat upon the degree of intensity, is from three to eight days. Either from

neglect of the primary affection or from some inherent idiosyncrasy the disease may become chronic; this, however, is rather a rare occurrence in young children. An acute progression into the severer forms is not very frequent.

Complications.—Bronchitis or catarrhal pneumonia may develop in the course of a catarrhal laryngitis as a result of the downward extension of the inflammatory process.

Diagnosis.—The diagnosis is not difficult. The hoarseness of the cry or of the voice, the cough, and the tenderness over the larynx will clearly indicate the seat of the affection. The mildness of the special symptoms, the absence of fever or its low degree, the undisturbed condition of the general economy, and the coincident rhinitis will indicate the type.

Prognosis.—The prognosis is always favorable; recovery is the rule.

Treatment.—The treatment is simple. The child must be kept in the house and if possible in one well-ventilated room, the atmosphere of which is maintained at an equable temperature. If the room be heated by a stove, a pot of water should be kept constantly thereon to moisten the air. Attention must be paid to the child's clothing that it shall be sufficiently warm, lest he should be chilled every time the door is opened or if he should happen to run out into an adjoining room or hall. If the bowels are costive, a laxative —*e. g.* a dose of castor oil—must be administered. When children object to taking oil or do not retain it upon the stomach, I have found the following formula answers the purpose very well:

℞. Mass. hydrargyri . . . . . grs. ij.
Syr. mannæ . . . . . f℥v.
Syr. rhei aromat. . . . . f℥iij.—M.
Sig. One teaspoonful every two hours till bowels are moved (for a child from two to four years old).

Or this.

℞. Aquæ laxativæ Viennensis (Ph. G.)[1] . . . . f℥j.
Syr. rhei aromat. . . . . f℥iij.—M.
Sig. One teaspoonful every two hours till bowels are moved.

For the local process in the larynx mild demulcent drinks are given, as warm milk sweetened, or milk and seltzer water, or oatmeal- or barley-water sweetened. Of medicines, some preparation of ammonia (I prefer the carbonate on account of its more agreeable taste), of ipecacuanha, or of both combined, or a combination of syrup of ipecacuanha and syrup of senega, will be of great benefit. For example:

℞. Ammonii carbonatis . . . . . grs. ij–v.
Syr. ipecacuanhæ . . . . . f℥ij–℥iij.
Syr. senegæ . . . . . f℥ij–℥iij.
Syr. tolutan. . . . . q. s. ad f℥j.—M.
Sig. One teaspoonful every two hours (for children from two to five years old).

[1] Very much like the infusum sennæ compositum of the U. S. P.; instead of Epsom, Rochelle salts are used.

For children under two years I use the following formula:

℞. Ammonii carbonatis . . . . . grs. ij.
Mucilag. acaciæ . . . . . f℥ij.
Vin. ipecacuanhæ . . . . . gtt. xxxv.
Syr. senegæ. . . . . f℥j.
Syr. tolutan. . . . . q. s. ad f℥i.—M.
Sig. One teaspoonful every two hours.

Externally a stimulating embrocation, as camphorated oil, with or without the addition of a little turpentine or of tincture of ginger, or amber oil, may be applied.

If the child be of sufficient age and of sufficient intelligence, an inhalation from a steam atomizer of a mild solution of sodium bicarbonate in glycerin and water (a few drops of carbolic acid can be added to the solution for its antiseptic properties) may be given twice a day. In very young children inhalations cannot be satisfactorily administered, and are therefore useless.

The rhinitis that is usually present should receive prompt attention. The nose should be sprayed every four hours; for this purpose either a 1 or 2 per cent. solution of menthol in albolene or some astringent solution, like the following, should be used:

℞. Cocaine hydrochlorat . . . . . grs. ij–iij.
Acid. tannic. . . . . grs. v.
Aq. destillat. . . . . f℥iv.
Hydrogen peroxide . . . . . f℥j.
Glycerini . . . . . f℥iii.—M.
Sig. Use as a spray.

If fever be present, a few small doses of quinine will allay it. The chocolate quinines (for very young children I have them powdered and administered in milk) are, by reason of their tastelessness, excellent for this purpose; two to four tablets may be given every four hours. If the cough is very troublesome at night, one-half to two grains of Dover's powder or five to fifteen drops of the syrup of Dover's powder, according to the age of the child, or a few doses of the bromide of ammonium, will procure a good night's rest.

Throughout, the diet should be a bland but nutritious one.

II. The Severe Form; Spasmodic Laryngitis (Laryngitis Stridulosa; Pseudo-Croup; Catarrhal Croup).

Symptoms.—The characteristic feature of the disease usually sets in suddenly. The child has been asleep for three or four hours, sleeping quietly, when, either with preceding manifestations of restlessness or suddenly, it wakes up with a suffocative attack. It coughs; the cough is short, barking, deep-toned; between the coughs the deep inspirations have a stridulous, crowing sound. Great anxiety is manifested by these little patients; very young children will want to be taken up and held upon the arm; older children will sit up in bed and clutch at the throat, as if to remove the obstacle they imagine there. The face is somewhat congested; the skin is bathed in perspiration, and the pulse is accelerated. Generally the accessory respiratory muscles are not called upon; at most there may be noticed a slight distention or increased movement of the alæ nasi. In very severe paroxysms, which are of exceptional occurrence, the accessory respiratory muscles are called into activity, the epigas-

trium and false ribs are drawn in on inspiration, and the face is somewhat cyanotic. The dyspnœa lasts for about a minute, a little longer in the very severe cases, when it begins to diminish in intensity, and in half an hour has entirely or almost entirely disappeared. In about an hour the child has quieted down, and soon goes to sleep again. It may cough several times during the night: that short, barking cough, without, however, being disturbed thereby. The next morning the child is apparently well; older children will want to get out of bed or even out of the room, and nothing but an occasional raw, barking cough remains to tell of what has occurred the preceding night Occasionally towards the afternoon the cough may become dryer and tighter, and the child have another suffocative paroxysm the succeeding night. This usually ends the matter, and nothing but a loose cough remains.

There may be some variation in this picture. The dyspnœa may last for a longer period than above described, although the child may fall asleep after a while; but even during sleep the inspiration will be attended by a stridulous or sawing noise. Or there may be no dyspnœa at all, nothing but the croupy, barking cough (and that is the phenomenon that fills the family with terror). This is more frequently the case when this form of catarrhal laryngitis occurs in older children, those beyond the fifth year.

It is stated that there may be a recurrence of the paroxysms for from three to five nights. In a large experience I have never seen such recurrence; in fact, never noted a recurrence on the second night. Steiner and Monti observed the recurrence of the suffocative attacks for ten or twelve nights; this was, however, more particularly noted in rachitic children. The special tendency of such children to laryngismus stridulus is perhaps no unimportant factor in the protraction of an attack of pseudo-croup.

The occurrence of an attack of spasmodic laryngitis during the morning or day sleep is exceedingly rare. Barthez and Rilliet state that they have occasionally observed the second paroxysm to set in during the early morning hours.

Frequently the paroxysms are preceded a day or a few hours by a mild catarrh of the upper respiratory tract—a coryza; there may have been some hoarseness of voice and some cough, but of so mild a character that no attention was paid to them by the parents, and no measures for their cure instituted. Or there may have been marked hoarseness and sonorous cough. Occasionally, and not infrequently, no such preliminary manifestations have occurred, the suffocative attack setting in suddenly after some prolonged exposure on the part of the child some hours previously.

As to the mechanism of the paroxysm of dyspnœa opinions differ. It is possible that true spasm of the laryngeal muscles may, in a certain category of cases, as in rachitic children or children who have at one time been afflicted with laryngismus stridulus, be a prominent factor in its production; in the majority of instances, however, it is undoubtedly primarily due to the increase of the tumefaction during sleep, when the child is lying down—to the dryness of the laryngeal and pharyngeal mucous membrane at this time, and the incrustation of mucus upon the vocal cords, still further narrowing the already somewhat contracted glottis, and producing an impediment to respiration sufficient to wake the child. That these are the main and necessary conditions for its production is proven by the rapidity with which the symptoms abate after the child has been taken up and some warm drink given it. It is also more than probable that the hoarse, barking cough with which the child usually awakes is the result of reflex irritation proceeding from the inspissated mucus—in other words, the attempt of nature to dislodge it.

There is not much elevation of temperature. I have never found the thermometer to indicate more than 101.5°–102° F. shortly after the abatement of the paroxysm.

Laryngoscopic examination will disclose considerable hyperæmia and tumefaction of the mucous membrane, especially of the ventricular bands, so that these may lie over the true vocal cords and the latter appear narrower. The vocal cords themselves may have a tumefied and rosy appearance, the tumefaction pertaining more particularly to their under surface. The mucous membrane of the thyroid cartilages, of the ary-epiglottic folds, and of the trachea, is considerably swollen, and either uniformly injected a deep red or hyperæmic only in spots; the surface sometimes presents a grayish appearance, as if it had been touched with caustic; this is undoubtedly due to a swelling of the epithelium. Incrusted mucus is also seen upon the interarytenoid mucous membrane and along the posterior portions of the vocal cords.

Course and Duration.—The disease with proper attention usually runs a mild course; the cough soon becomes loose and soft; there are no further returns of the paroxysms, and in from five to fourteen days the child has entirely recovered. It is well enough, however, to remember the fact, already mentioned, that there is a tendency to a recurrence of the disease with every fresh exposure.

Complications.—Bronchitis and broncho-pneumonia.

Diagnosis.—The diagnosis of pseudo-croup does not usually present any difficulties. The brief invasion, the characteristic paroxysm with its sonorous, barking cough, and the rapidity with which it passes, the time of onset, the rather mild febrile movement, are features sufficiently distinctive to make error almost impossible. The only two diseases with which it could be confounded are laryngismus stridulus and true croup. From the former it is readily distinguished by the cough, the hoarseness in the voice, and the fever—phenomena altogether wanting in laryngismus stridulus. From the latter, for which only a very severe attack of spasmodic laryngitis could be mistaken, the differential diagnosis can be made by remembering the following points: In true croup the symptoms are at the outset very mild and *gradually* grow in intensity. This increase in gravity continues both day and night. The difficulty in breathing grows by degrees, and continues so to grow till the climax, marked dyspnœa, is reached. The cough is harsher and more smothered. The voice is hoarse and rather muffled. There is a high degree of fever and great disturbance of the general economy. Furthermore, in 50 per cent. of the cases of true croup false membrane can be seen upon the tonsils, uvula, fauces, or pharynx. In pseudo-croup the suffocative attack comes on suddenly in the night, at once with maximum intensity, and abates entirely in a very short time. The cough is sonorous. The voice, soon after the paroxysm is over, regains tone, though it may be somewhat hoarse. There is much less fever and much less disturbance of the general economy.

Prognosis.—The prognosis is as a rule favorable; no death from pseudo-croup has ever been reported. Nevertheless, it should be a guarded one, for the reason that this form of catarrhal laryngitis may, either from total neglect or even insufficient attention to the child, progress into the grave form, or that a pseudo-membranous laryngitis may supervene upon the catarrhal, the inflamed mucous membrane forming an excellent nidus for the lodgement and propagation of disease germs.

Treatment.—Ordinarily the paroxysm *per se* does not require the attention of the physician; it is usually over by the time he reaches the house. Only in exceptional cases, where the paroxysm is very much prolonged, where

spasm of the laryngeal muscles has probably been excited by the laryngitis, must special measures for its abatement be instituted. For this purpose the child should be placed in a warm bath, temperature 100°–101.5° F., and allowed to remain therein from ten to fifteen minutes, so as to obtain its full relaxing effect; or a hot mustard foot-bath may be given in its stead. A sponge wrung out of hot water may be applied over the pomum Adami, as described farther on. Or 20–25 drops of ether may be given to a child two years of age, and if necessary it may be allowed to inhale a little. The ether acts by its relaxing effect on the laryngeal muscles and its expectorant effect on the mucous membrane. (For other remedial measures employed for this purpose see the article on Laryngismus Stridulus.)

The treatment of pseudo-croup, with the exception above noted, is rather simple. The remedy mainly indicated is one that has both expectorant and relaxing properties, and the one that best fulfils these indications here is some form of ipecacuanha. The formula I have employed with unvarying success is this:

℞. Vin. ipecac. . . . . fʒj.
Tinct. aconiti . . . . . ♏ ij.
Syr. tolutan. . . . . fʒiij.
Liquor. ammonii acetat. . . . . fʒi.—M.
Sig. Teaspoonful every hour till cough is loosened; then every two hours.

In children under two years I use the following formula:

℞. Liquor. ammonii acetat. . . . . fʒvj.
Tinct. aconiti . . . . . ♏ j.
Syr. ipecac. . . . . fʒiiss.
Syr. tolutan. . . . . fʒiss.—M.
Sig. Teaspoonful every two hours.

In these formulæ we have the expectorant properties of the ipecacuanha aided by those of the mild ammonium preparation and by the relaxing effect of the aconite. The liquor ammonii acetatis has, furthermore, diaphoretic properties very advantageous in the treatment of inflammations of the respiratory tract. The aconite acts as a febrifuge and is reinforced by the ipecacuanha.

If after twelve to eighteen hours I find that the respiration is still accompanied by a sawing noise, is still somewhat stridulous or whistling, although there is no dyspnœa present, I prescribe pilocarpine:

℞. Pilocarpin. hydrochlorat. . . . . gr. ½.
Acid. hydrochloric. dilut. . . . . ♏ v.
Aq. destillat. . . . . fʒiij.
Ext. ipecac. fl. . . . . ♏iij.
(aut, vin. ipecac. . . . . fʒj.)
Syr. scillæ . . . . . fʒiij.
Syr. tolutan. . . . . fʒss.—M.
Sig. Teaspoonful every two hours for a child two and a half years old.

I have never derived any benefit from the other preparations of ammonium usually employed, the muriate and the carbonate, in any form of acute subglottic laryngitis; on the contrary, I have always found them, more especially the latter, absolutely detrimental. I have had such uniform success with the

described remedies and formulæ that I have never had occasion to resort to opiates; and in this respect I agree with Bosworth that, as a rule, they should be avoided. Emetics are never required.

Externally, an application of camphorated oil, as already described, may be made, or a layer of fat bacon or a piece of fat salt pork, upon which some pepper is sprinkled, may be tied around the throat. Sometimes benefit is derived from the application of warm flaxseed poultices.

If rhinitis be present, it will be treated as already described in the previous section.

The child must be kept in a warm, well-ventilated room, and under no consideration allowed to be taken out or to go out. After five or six days, if the disease have progressed favorably and the weather be good, it can be taken out for a couple of hours during the warmest part of the day. The diet must be bland, but nutritious. The bowels must be kept soluble.

III. The Grave Form. (Laryngitis Hypoglottica Acuta Gravis; Acute Subglottic Laryngitis, of Grave Form; Spasmodic Laryngitis, Severe Form; Catarrhal Croup.)

Symptoms.—This form of catarrhal laryngitis is almost always an acute progression of one or the other of the milder forms. This progression may be slow, requiring from five to ten days till the climax is reached, or it may be very rapid, thirty-six hours to two days. It is marked by an exaggeration of all the phenomena above described. The suffocative paroxysms are of greater intensity and of longer duration; in fact, once established, the dyspnœa is continuous, with but temporarily diminished intensity during longer or shorter intervals. Usually the onset is marked by increased frequency of cough, which is short, hoarse, and markedly croupal; it is a dry cough; it is painful, the child crying between the coughs and complaining that it hurts him. The voice is very hoarse or altogether extinguished. The effort at speaking is frequently painful, and the little patient will indicate his wants by pantomimic motions. Then the respiration becomes somewhat difficult and rather loud, and the child becomes restless and irritable, and wants to be held upon the mother's arm or lap. After a longer or shorter period, preferably in the night, the suffocative paroxysm manifests itself in all its severity. The cough is continuous, hoarse, barking, short; it is not sonorous, rather more muffled; the respiration whistling and long drawn; the long-drawn, stridulous, crowing, or hissing inspiration, interrupted by short, hoarse, rather muffled coughs, and followed by the prolonged expiratory sound, can be heard at a distance. With every respiration the larynx makes marked excursions. All the accessory respiratory muscles are brought into full play; the sterno-cleido-mastoid, the pectoral, the serrati, and other muscles are observed acting energetically. With every inspiration the thorax is markedly elevated, whilst at the same time the jugulum, the intercostal spaces, and the epigastrium sink in deeply; on the following expiration the thorax does not at once return to its normal position, and the active efforts of the abdominal muscles are required to effect this. The veins of the neck are distended and filled with dark blood. The extremities are slightly cyanotic. The skin is somewhat turgid; perspiration may be abundant over the whole surface, or only a cold, clammy sweat cover both head and face. These symptoms persist, with perhaps somewhat lessened intensity, throughout the night; generally toward morning there is more marked abatement; the child will fall asleep, gain a few hours' rest, and wake up again with another suffocative attack. The cough is now almost toneless,

occurs at but long intervals, and is very short. If the voice was only hoarse at the outset, it is now altogether abolished. The respiration is much more difficult; all the accessory respiratory muscles are in activity; the whole attention and energy of the patient are directed to his breathing; the stridulous, sawing noise accompanying inspiration is still more marked. The child cannot lie down, but sits propped up in bed or upon the mother's lap. Gradually there is an apparent relaxation in the patient's efforts at breathing; he lies back a little more; the pulse becomes small and thready and extremely rapid; the face assumes a pale, cadaveric appearance; the child becomes comatose or delirious, and death supervenes either from asphyxia or in an attack of general convulsions.

Exceptionally the laryngitis may be of the grave type from the outset, its first manifestations being the severe suffocative paroxysm just described.

The course, however, is not always so stormy: in rare instances the progress of the disease is very insidious; the symptoms are of a comparatively mild character, until suddenly, without any warning, death seems imminent. The child has a laryngitis of mild type, to which no attention is paid, and he is allowed to run around at pleasure. After a few days, perhaps a week, he becomes aphonic; there is but little cough, and that very much muffled and dry. Suddenly the parents observe that the child, which has lain down, is evidently unconscious; the eyeballs are rolled up under the upper lids, the face is cyanotic or of cadaveric paleness; the body is cool; the pulse very feeble, nearly imperceptible; the respiration almost completely arrested. With an effort the child may be recalled to consciousness for a few moments, but he will quickly relapse into the state of stupor, from which he may never awake.

The fever, except in the class of cases last described, is always very high; the thermometer ranges from 102° to 103° F. at the onset, and from 104° to 105° and higher at the period of greatest intensity. There is generally great thirst, the patient constantly craving cold drinks, of which he will take but a sip, on account of the interference with respiration. The appetite is completely gone, and it is with greatest difficulty that the child can be persuaded or made to take a little milk or beef-tea.

When the disease tends toward recovery the severity of the symptoms gradually abates, and when convalescence is fully established they have all disappeared, with the exception of the aphonia, which frequently continues for a considerable time; or, even if the voice be regained soon, it will have a husky tone for quite a long time.

Laryngoscopic examination discloses an exaggeration of the picture described in the previous section. The mucous membrane of the whole larynx and trachea is markedly hyperæmic and swollen; the ventricular bands are greatly injected; the vocal cords are either pinkish or normal in color; beneath these, projecting into the line of vision, can be seen the deep-red or almost purplish rounded masses of tumefied subglottic tissue, bellying out far beyond the line of the true vocal cords and narrowing the glottis down to a slit. On the free border of these folds of infiltrated subglottic tissue the muco-purulent secretion collects, becomes inspissated, and forms ragged and jagged incrustations, which tend to still further aggravate the stenosis. As the disease abates these incrustations disappear, and the folds diminish in size and become pale in color.

Course and Duration.—The course and duration of the disease depend to a great extent upon the degree of intensity developed, upon the period at which medical treatment is resorted to, whether early or late, and upon the mode of treatment. Usually with a sufficiently energetic treatment the acute

symptoms subside in from two to three days. They never last over five days. The duration of the disease from its onset to its definite cure may occupy a period of from two to three weeks.

Complications.—Bronchitis, broncho-pneumonia, convulsions.

Prognosis.—The prognosis will depend in a great measure upon the period at which the physician first sees the case. If at an early period, before the pathological process has involved the submucous tissues, before the disease has reached its climax, a favorable prognosis can usually be made at once. If, however, he is called at a late period, when the laryngeal stenosis is already very marked, it should be very guarded, and more especially so if the condition be due to too early exposure after measles. In my experience these have been the hardest to deal with, and I have seen such cases die despite tracheotomy, despite intubation. Then it must be remembered that one or the other of the complications mentioned may develop and carry off the patient.

Treatment.—In the early stage, when the grave form is just developing, when, although the voice is very hoarse or altogether lost, the short cough is still somewhat sonorous or but slightly muffled, the respiration is still comparatively easy, without very much stridor, excellent results will be obtained with very small doses of tartar emetic:

℞. Antimonii et potassii tartrat. . . . . gr. $\frac{1}{3}$–$\frac{1}{2}$.
Syr. tolutan. . . . . f℥ss.
Aq. destillat. . . . . f℥iss.—M.

Sig. One teaspoonful every two hours, for children from two to four years old. If this dose produces emesis or nausea, but one-half to one-third of a teaspoonful are subsequently given.

When the disease is fully developed and the dyspnœa great, energetic treatment is required.

It is in this form of catarrhal croup that the emetic finds its justification, and should be promptly administered.

The preferable one here again is tartar emetic:

℞. Vin. antimonii . . . . . .
Oxymel. scillæ . . . . . āā f℥ss.—M.

Sig. One-half to one teaspoonful every ten or fifteen minutes till emesis results.

Or it may be combined with ipecacuanha:

℞. Vin. antimonii . . . . . f℥iij.
Syr. ipecac. . . . . f℥v.—M.

Sig. One-half to one teaspoonful every ten or fifteen minutes till the desired effect is obtained.

Or the compound syrup of squills may be employed, though the stimulating character of the squills and senega contained therein makes it less desirable than the preceding formulæ. If the effect be delayed, it can be hastened by tickling the fauces with the finger or with a feather. After this the antimony is continued in fractional doses, as above described.

If, despite free emesis, the dyspnœa continues marked and threatening, the application just above the manubrium sterni, or the jugulum, of from two to six leeches, according to the age of the child, is recommended by some authors. Though bleeding is not favored by many pædiatrists, nevertheless in children

of full habit, and if care be taken to arrest the hæmorrhage promptly as the leeches fall off, the measure will undoubtedly be of great benefit. If the stridor in the respiration continues marked, though the dyspnœa has greatly abated, the application of a blister to the neck at the side of the larynx, followed by a dressing of unguentum hydrargyri, is likewise recommended by some writers.

If the bowels are confined, they should be freely moved, and for this purpose a dose of calomel, alone or in combination with sodium bicarbonate, may be prescribed; and if its action be tardy, it can be hastened by an enema of water or of glycerin.

J. Forsyth Meigs recommended the following formula as one that had given him good results:

℞. Hydrarg. chloridi mitis . . . . . gr. vj.
Antimonii sulphuret. præcipitat. . . . . gr. j.
Potass. nitrat. . . . . gr. xij–xxij.—M.
Ft. pulv. et divide in part. æqual. No. xij.
Sig. Powder every two hours.

He also stated that in some cases where, despite emetics, bleeding, and antimony, the dyspnœa had gone on for four or five days, it yielded rapidly under the sedative and cathartic effect of four grains of calomel administered in one-grain doses every hour.

Rauchfuss reports some cases that he treated with calomel in small doses internally, and inunctions of mercurial ointment, with excellent results.

In addition to the measures already described, inhalations from a steam atomizer or sprays of a solution of sodium bicarbonate, with the addition of a little carbolic acid,[1] will prove of great advantage.

During the paroxysm counter-irritation by means of mustard plasters can be resorted to, or the measure so highly recommended by Trousseau may be employed: A sponge is dipped in water as hot as can be borne, placed under the chin, and gradually pressed out, so as to have the hot water flow over the larynx; in ten or fifteen minutes the process is repeated. Rauchfuss also recommends cleansing the pharynx and the vestibulum laryngis by means of the finger, brush, or the cotton-holder wrapped with cotton, and believes that by the coughing and choking thereby excited better results are obtained than with an emetic. Or the administration and inhalation of ether, as already described, may be resorted to.

Warm drinks, especially warm milk, should be freely given. Even when the child has fallen asleep after the subsidence of the most threatening symptoms, it should be awakened every few hours and a warm drink given it, and, if it be old enough, an inhalation, to keep the parts moist and thus prevent a return of the paroxysm.

When, despite these measures, the dyspnœa grows greater and asphyxia is imminent, as indicated by stupor, and by rolling up of the eyeballs underneath the upper lids; or if these symptoms have already supervened at the time the physician is called, intubation or tracheotomy should be at once resorted to.

[1] ℞. Sodii bicarb. . . . . ʒj.
Sodii benzoat. . . . . ℈iss.
Acid. carbol. cryst. . . . . ♏ xij.
Glycerin. . . . . f ʒj.
Aq. destill. . . . . f ʒij.—M.
Sig. Two teaspoonfuls with an equal quantity of water in cup of steam atomizer.

After the imminent danger has been averted one or the other method of treatment can be employed. If antimony be selected, it should be the wine that is directed, and in such small doses that it cannot produce retching or emesis, so as not to dislodge the tube. Intubation is, in my opinion, to be preferred to tracheotomy for the middle and poorer classes, as it is almost impossible for them to give the necessary attention to the patient that is required after the operation. The tube can be removed in from twelve to twenty-four hours.

During the attack the child must be kept in bed in a well-ventilated room, the atmosphere of which should have a certain amount of moisture; after subsidence of the attack, although he may be allowed to be up in the room, great care must be taken that he shall not run out or expose himself in any way.

Convalescence being fully established, the warm drinks may, to a great extent, be withheld and the moisture of the room markedly lessened. The inhalations can be continued for some time, a weak astringent solution (alum 1 per cent.) taking the place, later, of the soda solution.

An accompanying bronchitis or coryza must not be neglected.

Prophylactic Treatment.—With children who have a tendency to catarrhal affections of the upper respiratory tract a prophylactic treatment should be instituted early. They should be accustomed in the summer months to cold bathing, cold sponging, and cold frictions. If possible, they should be taken to the sea-shore or to the mountains for the summer. In winter, after being washed with warm water, the face, neck, and hands should be sponged off with cold water (just as it flows from the hydrant); after their warm bath (which should always be given in a warm room) the body should be well rubbed with cold water or cold alcohol and water, and thoroughly dried. They should not be allowed to keep on topcoats or hats or shawls whilst in the house, or to run out of the house insufficiently clad. They should be dressed properly and not made sacrifices to the vanity of their parents, especial attention being paid to their foot-gear that it be water-proof; during wet or snowy weather the shoes should be changed two or three times in the day. Their diet should be plain and wholesome, and not too stimulating. They must not be overburdened with studies. They should be allowed sufficient exercise in the fresh air, even on very cold days, but with the direction that as soon as tired they must come into the house to rest: they must not rest out of doors.

If the children are anæmic or have a scrofulous taint, the proper remedies must be administered.

LARYNGISMUS STRIDULUS.

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This condition—termed also Spasmus glottidis (spasm of the glottis); Asthma Millarii; Asthma thymicum Koppii (thymic asthma); Asthma rachiticum—consists of paroxysms of spasmodic closure or narrowing of the glottis, causing complete or almost complete arrest of respiration, and occurring at longer or shorter intervals.

Laryngismus stridulus is a neurosis of the larynx, that organ being generally in a healthy state. It is an affection entirely distinct from spasmodic laryngitis (pseudo-croup), with which it has been identified, especially by many English writers. It is not to be confounded with true infantile asthma, which is an entirely different disease. Neither must it be confounded with internal convulsions (inward spasms), though it is true that spasm of the glottis may occur in inward spasms, and, *vice versâ*, inward spasms may occur in the course of a protracted case of laryngismus; in either instance, however, it is more in the nature of a complication which adds to the dangers of the primary affection and makes its prognosis more unfavorable.

The paroxysm sets in always during inspiration, and is produced by spastic contraction of the muscles which normally possess the function of narrowing or closing the glottis—the adductors, the two thyro-arytenoids, the two lateral crico-arytenoids, and the arytenoideus muscle. This abnormal muscular action is the result of irritation, either direct or reflex, of the laryngeal recurrent nerve, or of the vagus above the point where the laryngeal recurrent is given off.

Escherich, in his address before the Tenth International Congress, clearly indicates his belief that laryngismus stridulus is not a morbid entity, but merely a symptom of another affection—namely, latent tetany. He claims to have found the characteristic symptoms of the latter disease (Trousseau phenomenon, etc.) in all the cases presenting themselves for treatment for laryngospasm. Loos by his investigations confirms the views of Escherich. He also affirms that in all cases coming under his observation for laryngospasm he found, like Escherich, the characteristic symptoms of tetany. In his summary he says that it remains to be proven whether we ever have laryngospasm independent of the other symptoms of tetany.

The disease is somewhat frequent in France; more prevalent in England and Germany. From the latter country we have the greatest number of cases reported. According to good authority, it appears to be much more frequent in certain localities there than in others. In this country it is exceedingly rare, and but few American physicians have the opportunity of studying it by personal observation. This rarity is, I believe, readily explained by the fact that pap-feeding to infants is almost entirely unknown here.

Laryngismus stridulus is essentially a disease of infantile life, from birth to the close of the first dentition—two and a half years. The period of most frequent occurrence is, according to Friedreich, from the fourth to the fourteenth month. Barthez and Rilliet have observed the spasm almost exclusively between the third week and the eighteenth month; Flesh, between the fifth week and twenty-first month. Of 226 cases of laryngospasm observed by Steiner, 174 were in their first year, 52 in their second or third year. Salathé saw four cases of laryngospasm in new-born infants; Bowen, a fatal case in an infant six days old. The majority of cases occur undoubtedly between the fourth and eighteenth months. This, however, does not preclude the occurrence of the disease at a much later period of child-life: Steffen reports a case of spasm of the glottis in a boy eight years old; Salathé, one of a child of twelve years.

As regards sex, it is the consensus of observers that male children are more liable to the disease than female children. This is very clearly demonstrated by Steffen: of 554 cases compiled by him, 386 were boys and 168 were girls.

The greater number of children attacked are rather stout and present a bloated appearance, as if they had undergone the stuffing process; much less frequently are really atrophic children affected. Most of them are markedly nervous; they do not sleep very well, cry a great deal and without cause, have a tendency to holding-breath spells, have very bad tempers, and want to be carried around the greater part of the time.

The disease is most prevalent in the cold months of the year, winter and early spring, especially in March. Some would have this frequency due to the greater prevalence of catarrhal conditions at these periods. According to Flesh, it is due to the fact that children are kept much more confined to the house during these months. The experience of Mr. Robertson seems to fully corroborate this: he recommends "the free exposure of the infant out of doors for many hours daily to a dry cold atmosphere, and, if the air be dry, the colder the better." It is more frequent in northern than in southern latitudes.

Etiology.—The etiological factors of this disease can be properly divided into two groups: the *constitutional* and the *local.*

Constitutional Causes.—*Rickets.*—Two-thirds of the children affected with laryngospasm present the stigmata of rickets, and some of these can be detected as early as the third month. The causal relation between the constitutional state and the laryngospasm is therefore apparently established; as to its nature, opinions differ. Elsässer believed that it lay in the craniotabes. This view has, however, been sufficiently controverted by the observations of many that the paroxysms occur not only when the child is lying down, but also when it is held up upon the arm or sitting up in its chair, and no pressure upon the head made. Furthermore, in many cases craniotabes has been found altogether wanting, although other symptoms of rickets were present.

In children afflicted with rickets the general nervous irritability is morbidly exaggerated. This Steffen holds responsible for the laryngismus. Moreover, by reason of the characteristic change in the shape of the thorax the respirations are more superficial and necessarily more frequent. Now, if, by any cause, as an attack of coughing, screaming, great fright, swallowing the food too hastily, sudden awakening or being awakened, sudden change of temperature from warm to cold (when the child is carried from a warm to a rather cold room), the uniform rhythm of respiration is interrupted, a hyperæmia of the brain and medulla is produced, and the conditions favorable to the production of a spasm of the larynx developed.

Flesh admits the very frequent coincidence of laryngismus and rickets as set forth, but does not believe in the causal relation of the latter to the former.

For him, not the rachitis, but the factors that gave rise to the cachexia, are the causes of the laryngeal spasm. "Faulty nutrition and injurious food, this and nothing else, are the *fons et origo* of spasm of the glottis."

Heredity.—Instances have been reported where the greater number or nearly all of the children of one family were affected with this neurosis. An hereditary predisposition has therefore been presumed. The cases, however, really prove nothing more than a continuance of the same vicious mode of nurture that called forth the disease in the first child; for in other instances, where already two or more children had been affected, better attention to hygienic requirements and correct feeding kept all the subsequent children free therefrom. The supposed special hereditary influence as an etiological factor has been discarded by most authors.

Local Causes.—*Dyspepsia;* over-filling of the stomach; intestinal catarrh; over-distention of the intestines by fæcal masses; great flatulence. Kopp's theory that the disease is always due to enlarged thymus gland has been proven untenable by Friedleben and others. In rare instances it may be the etiological factor. Bronchial or tracheal glands enlarged or undergoing caseous degeneration, diseases of the heart, and enlarged liver are occasional causes of the spasm. Material diseases of the brain do not, according to Steffen's observations, produce spasm of the glottis. Kyll quotes a case from Corrigan of Dublin which, despite all treatment, had lasted over three months. Accidentally it was discovered that pressure over the third and fourth cervical vertebræ was very painful and produced loud cries from the child. Two applications of four leeches, at an interval of two days, over the painful point removed all the symptoms and the child made a perfect recovery.

Dentition is banished by many from the category of causes. Nevertheless, it is not at all improbable that in such vitiated states of the system, with perversion of many of the physiological functions, as the majority of the children present, the process of teething has a certain causative influence in the production of morbid phenomena.

Catarrhs of the larynx, trachea, or bronchial tubes cannot of themselves produce spasm of the glottis by reflex irritation, but when they supervene in cases where it already exists they will aggravate it, and even recall it if it be disappearing.

Mantel reports the case of a rachitic infant eight weeks old, in whom a very much thickened, congested, and elongated uvula appeared to be the cause of the spasm; its removal, after other measures had failed, was followed by perfect recovery.

J. H. Bryan reports the case of a child suffering since its second week with tonic spasms of the larynx. The epiglottis was found irregular in outline and bent backward over the laryngeal cavity. The child also had a phimosis, and was fed upon undiluted cow's milk. The spasm was attributed to a binding of the epiglottis, causing the aryteno-epiglottic folds to come almost into apposition, so that a slight stridor was produced on inspiration. With reference to this last point, it is well known that a certain amount of recurvation of the epiglottis is normal in young children, and cannot be regarded as a cause of the spasm. This seems confirmed by the results of the treatment in the case just referred to. On diluting the milk and relieving the phimosis by gradual dilatation the respirations lost their spasmodic character and became normal. Whether the phimosis had any direct effect in the production of the cramp remains to be determined by further observations: that it may give rise to morbid nervous phenomena is well known.

In easily excitable children violent and prolonged crying, undue exertion

in running so as to materially interfere with the respiration, are capable of provoking a mild attack of spasm of the glottis.

In a small number of cases, and more particularly of those occurring after the third year, no special cause for the cramp can be discovered. According to my observation, a hot, vitiated atmosphere in the sleeping apartment, whole families sleeping in one room, two, three, or more children in one bed, with doors and windows tightly closed, will account for some of these. In support of this view I would recall here the influence of this factor in the production of trismus.

Pathology.—The structural changes found upon necropsy vary considerably. In so far as the spasm itself is concerned, the results are entirely negative, nothing abnormal having as yet been discovered either in the nerves or the muscles of the larynx.

In the majority of cases the rachitic changes in the bones and soft tissues present themselves. Craniotabes is frequently found wanting. Various morbid changes are found in the brain, mainly those due to the cachexia. In rare instances softening of the medulla oblongata has been seen. In the larynx traces of catarrh have been found; occasionally a croupous exudation upon the larynx and trachea; very rarely ulceration. Bronchial or tracheal glands enlarged or undergoing caseous degeneration are sometimes found. The thymus gland is occasionally voluminous and juicy. A variable degree of pulmonary emphysema, as the result of the spasm, is always present. Various cardiac lesions have been noted.

The stomach is not much affected. In the jejunum and ileum the solitary glands and Peyer's patches are enormously swollen, broad, and pale; concomitantly we have hyperplasia and sometimes caseation of the mesenteric and retroperitoneal glands. The liver presents evidences of fatty degeneration.

Symptoms.—A typical paroxysm presents the following picture: Suddenly, without any prodroma on the part of the larynx or the other respiratory organs, the child, who has just been sleeping nicely or has been lively and playful upon its mother's arm, in its chair, or has perhaps been a little fretful and crying, is seen to gasp for breath. It becomes rigid; the head is thrown back and the neck arched forward. The face, more particularly about the nose and mouth, becomes pale, cyanotic, or dusky red. The alæ nasi are distended, and the forehead is covered with a cold perspiration. After a few seconds to a quarter of a minute a few whistling or crowing inspirations are heard; arrest of respiration again follows, lasting from a few seconds to a minute, when the whistling sounds are again heard. After two or three more repetitions of this alternate crowing inspiration and arrest of respiration the crowing inspirations are followed by expirations, the child can soon cry out lustily, normal respiration is established, and the paroxysm is over. These whistling or crowing sounds are made by the entrance of air through the narrowed glottis, and are not followed by expiration until the spasm is over. In the milder forms these crowing sounds are heard several times in each paroxysm; in the very gravest form they are heard only at the beginning and end of the paroxysm, respiration being entirely arrested during the middle period. When the closure of the glottis is complete, the thorax, diaphragm, and abdominal muscles become immobile; when it is incomplete, laborious respiratory attempts on the part of the various muscles concerned may be noted. The heart's action is at first stronger but irregular, then feebler and more frequent, and the pulse becomes small, sometimes barely perceptible. The severer the seizure the earlier there is loss of consciousness. Frequently there is involuntary discharge of the urine and fæces.

The paroxysms vary in severity. In the mildest form, which may pass unnoticed by the parents, especially if it occur during the night, there is but a momentary suspension of respiration, followed by a few whistling or crowing inspirations, and the attack is over.

The number of seizures in the twenty-four hours varies from a few to as many as thirty or forty. Frequently a few seizures will follow each other in rapid succession; then a longer period of rest and well-being for the child ensues, to be interrupted again by a recurrence of the spasm. It has been observed that the shorter the intervals between them the milder are the paroxysms. A number of very mild attacks may be followed by a very severe one. The spasm cannot last longer than two minutes at most without bringing about a fatal issue. The paroxysms occur as frequently in the daytime as during the night; there is no special predilection for the night, as has been supposed by some. With the progress of the disease convulsive phenomena—namely, tonic spasms in other parts of the body—generally make themselves manifest. The earliest and most frequent are the so-called *carpopedal* spasms. The thumbs are drawn into the palms and the fingers extended in various directions. The great toe is adducted and drawn upward, and the other toes spasmodically flexed. Sometimes the hands are bent upon the forearm and the forearm upon the arm. The dorsum of the foot may be drawn up firmly against the shin. The ocular nerves also become involved very soon, as shown by the rolling up of the eyes. Clonic spasms occur only when a general eclamptic seizure supervenes, which, according to Henoch, is not so infrequent.

The disease is *apyretic*. When fever does set in it generally depends upon some intercurrent affection. Symptoms of dyspepsia are almost always present: eructations, flatulence, constipation, clay-colored stools; very rarely diarrhœa or vomiting.

In older children—*i. e.* after the third year—the tendency to laryngeal spasm is markedly lessened. This may be accounted for upon the ground that they have arrived at a period of greater digestive power, when the problem of nutrition is very much simplified, and also one of greater stability of the nervous system. The paroxysms, when they occur at this later period, are much less severe, probably for the reasons above mentioned, and the further reason that the larynx at this age has grown wider and the cartilages have become firmer. When these children feel the respiration becoming impeded they grow fretful and want to lie down. The face becomes pale, never cyanotic or dusky red. The whistling or crowing sounds are not very marked or do not occur at all, and the only complaint is of a tightness about the throat and an inability to swallow. The voice is feeble and speech labored. The cramp lasts at longest but a few seconds, and when it is over the child is as cheerful and apparently as well as before.

Course and Duration.—The course of the disease is rather irregular. It may set in with great intensity, the paroxysms being very severe and recurring at short intervals; again, it may begin in a very mild fashion, a few rather mild paroxysms recurring at longer intervals, with periods of entire freedom of from ten to twelve days. Usually, however, it runs a circuit of aggravation, climax, and diminution. Until the climax is reached seven to eight weeks may elapse. There is also considerable tendency to relapse: even after an interval of months of entire freedom, under the influence of exposure, of an inflammatory attack of some part of the respiratory tract, or of a fit of indigestion, the spasm may reappear, and with greater intensity than characterized it previously. The duration of the disease is rather uncertain: the first attack may prove fatal;

it may prove fatal in a few hours or it may last for months. Flesh avers that since he has recognized the true nature of the disease he has been able to effect marked improvement in all his cases in a very short time, and cites a case which was discharged well at the end of a month.

Complications.—The complications that may occur in the course of a case of laryngismus are many. When the disease is of great severity, transudations between the membranes of the brain, into the ventricles, may occur, or already existing effusions (of rachitic origin) may be dangerously increased. We may have effusion of blood between the membranes or upon the brain itself.

Whooping cough is a dangerous complication. Catarrhs of the larynx, trachea, and bronchial tubes have been already mentioned. Inflammatory affections of the lungs may supervene; during their continuance the spasm is generally much weaker or ceases altogether.

The most frequent complications are entero-colitis and eclampsia.

Diagnosis.—In uncomplicated cases the diagnosis is readily made. The suddenness of the seizure, the brief duration of the apnœa, the intervals of perfectly undisturbed normal respiration, the absence of fever, of cough, of change of voice, are features so distinctive that it is not possible to mistake the disease for croup, œdema of the glottis, or other organic disease of the larynx. The only disease with which it could possibly be confounded is spasmodic laryngitis (pseudo-croup), but spasmodic laryngitis has so different a clinical history that the differential diagnosis is not difficult. From bilateral paralysis of the glottis-dilators it is readily distinguished by the absence of the constant and marked dyspnœa which attends that condition. If there should be any doubt it can be readily solved by a laryngoscopic examination.

In complicated cases, especially where eclampsia follows in the wake of laryngismus, the diagnosis may be more difficult, likewise in those cases where a catarrhal affection of the larynx and trachea has supervened; however, a history of the case from its onset will very soon enable us to arrive at a correct conclusion.

Prognosis.—The prognosis should always be a guarded one, even in the very mild cases. Older statistics show a great fatality. Of 289 cases observed by Reid, 115 ended fatally. Rilliet and Barthez had 9 cases with 8 deaths; Herard, 7 cases with 6 deaths. Henoch, however, has had a more favorable experience: he says that the majority of the cases recover. Flesh reports that in the last twelve years he has lost but two cases.

Of course much will depend in any case upon the character of the surroundings of the child, the severity of the paroxysm, the degree of impairment of the general health, and the intelligence of the parents. In children past thirty months a favorable prognosis can generally be made.

Treatment.—This can best be considered under two heads: I. The temporary relief of the spasm. II. The cure of the underlying pathological condition.

I. From the brief duration of the spasm the physician is but rarely present when it occurs; and only accidentally, or if the paroxysms recur at short intervals, may he happen to witness it. The treatment, therefore, for the temporary relief of the spasm lies mainly in the hands of the mother or nurse, and she should be properly instructed. In light cases it is not necessary to intervene at all; only when the paroxysm is of longer duration or when it is made up of a series of attacks should measures for its arrest be instituted. The tongue should be looked after to see that it is not curled back over the laryngeal orifice, as occasionally happens. A large evacuating enema should be given at

once. The child should be placed in a semirecumbent position, all clothing loosened, and an abundance of fresh air provided. Cold water may be splashed into the face and upon the chest, or sinapisms applied to the back of the neck and to various parts of the chest to excite respiration. A piece of ice wrapped in a cloth and applied over the epigastrium and lower part of the sternum has occasionally proved effective. Ammonia or ether may be held to the nose. Chloroform inhalations, recommended by Simpson, West, and others, are not regarded with much favor, probably for the reason that it is a dangerous remedy to leave in the hands of laymen, and for the further reason that when the respiration is completely arrested it can do no good. Morphia is highly spoken of by Henoch. It is given until drowsiness is produced, then stopped. A rectal injection of chloral hydrate, gr. v, in milk of asafœtida, fʒij, will very frequently prove effective. Pressure on the pneumogastric nerve, on the carotid arteries, is recommended. The fauces may be tickled with the finger or with a feather until emesis results. Morrell Mackenzie recommends putting a pinch of snuff into the child's nose to produce sneezing.

If the paroxysm be of great severity, cyanosis marked, and apnœa persistent, the child may be placed in a warm bath (temperature 95° F.), whilst cold water is dashed from a height upon the head and face; or the child's feet can be placed in a hot mustard foot-bath and a cold compress applied to the head. If the apparatus be at hand, the application of a strong induction current to the phrenic nerve, or of a galvanic current to vertebræ and thorax or over vertebræ and larynx, may prove beneficial. If the danger be imminent, intubation should immediately be resorted to; if that alone prove ineffective, air can be blown into the lungs through the tube and expiration promoted by pressure on the sides of the thorax. Tracheotomy is not in favor.

Flesh, who has had a large experience, deprecates, as a rule, all interference with the child, with the exception of the evacuating enema. He asserts that all the other various measures resorted to are not only not beneficial, but positively injurious.

As soon as the child can swallow the best remedy to be administered is musk, as tincture, in doses of 10–15 drops, or after the following formula (Mackenzie):

℞. Moschi . . . . . gr. iss.
Sacchari albi . . . . . .
Pulv. acaciæ . . . . . *āā* gr. ij.
Syr. aurantii florum . . . . . ♏xx.
Aquæ . . . . . ad fʒj.—M.
Sig. For one dose, to be given every two hours.

Tincture of castor and tincture of valerian are also recommended.

In the interval, to prevent recurrence, or at least to modify the severity and frequency of the paroxysms, numerous remedies have been recommended: musk, castor, valerian, bromide of potassium, bromide of sodium, and chloral hydrate are the most effective. The selection of the remedy will depend in a great measure upon the condition of the child; in feeble children chloral hydrate should rather be avoided; in dyspeptic cases the bromide of sodium will be preferred. Scarification or lancing of the gums is of no benefit, and therefore unnecessary.

Care must be had that the child be not vexed or irritated, especially for the first forty-eight hours after instituting treatment; its wishes should be complied with and its whims humored. Some friendly face should be with the

child when it goes to sleep, and more particularly when it is about to wake up, so as to avoid all fright. Proper attention must be paid to the ventilation of the room and to all other hygienic requirements. The child must be taken out into the fresh air whenever the weather permits; the experience of Robertson in this respect has been already referred to.

II. The principal point to be kept in view is undoubtedly the cure of the underlying pathological condition. All authors agree that the diet must be strictly regulated and all farinaceous food prohibited. All aliment must be given in fluid form, as thin as water. The only articles permitted are milk and beef tea. If the child be at the breast and the supply be ample, no other food must be given. If bottle-fed, the bottle must be put aside and the child fed with a spoon or feeding-cup. The milk must, at first, be diluted one half with water. It is of the greatest importance that the number of meals and the intervals at which they are given be properly regulated.

In children under four months six meals per day at intervals of three hours are allowed; over that age, only five meals per day are given. If possible, nothing should be given in the night; if the child wake up and cry for its accustomed food, a little water can be given it, and after a while it will fall asleep again, and thus in two or three nights the habit of taking food at night may be broken up. As to quantity, at the outset not more than one half of the normal quantity, according to the child's age, should be given at one feeding. As the digestion improves, as shown by the improved character of the stools, the milk is diluted but one-third, and the quantity gradually increased, until the child gets about the full quantity for its age. When the stools have become normal and have continued so for some time, Flesh recommends, for children over six months old, the addition to the beef tea of a small quantity of boiled lean beef finely chopped, and claims for it great restorative powers. After there has been no recurrence of the stridor for weeks, and not till then, a little zwieback or dry roll may be allowed; at first but very little, and if well borne gradually increased. No solid food must be given till after the child has passed its second year.

The remedies employed in conjunction with this treatment are, in rachitic cases, cod-liver oil and phosphorus. Of the latter agent Baginski says that in some cases it has proved remarkably effective, inhibiting the paroxysms even before any effect upon the rachitis was noted. Where marked anæmia exists some preparation of iron is indicated. For enlarged glands the syrup of the iodide of iron or iodide of iron and manganese must be prescribed.

Local causes must be properly attended to; complications must be treated according to their nature.

FOREIGN BODIES IN THE LARYNX, TRACHEA, AND BRONCHI.

By JOHN B. DEAVER, M. D.,

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The entrance of a foreign body into the larynx or any of the more remote portions of the air-passages is, fortunately, a condition of somewhat rare occurrence. When such entrance does happen, it is, in the majority of instances, by way of the mouth, but it may also occur through penetration of the walls of the larynx or trachea. The infrequency of such accidental lodgements as may occur through the normal opening of the larynx is directly due to the rapidity with which the orifice is closed by the epiglottis.

A foreign body having, however, entered the cavity of the larynx, it is very likely to have its downward progress arrested by the apposition of the contiguous borders of the aryteno-epiglottidean folds and the true vocal cords, and to be expelled from this position by the cough which its presence excites. On the contrary, it may, owing to relaxation of the vocal cords, pass through the glottis, and into the trachea or one or other of the bronchi. It is rather exceptional for a foreign substance to enter the larynx during deglutition, except where there is paralysis of the gustatory muscles, such as may follow diphtheria, or where, as the result of ulceration, there is a partial or complete destruction of the epiglottis. Strong inspiratory efforts while feeding or while the mouth contains any substance are most frequently responsible for the entrance of particles of food or other material into the larynx. A sudden attempt to breathe, laugh, or speak, a sneeze, or a sudden blow, all favor the occurrence of such an accident through relaxation of the muscles.

The amount of obstruction occasioned by the entrance of a foreign body into the air-passages depends upon the character as well as the size of the object. If of organic nature, such as a bean, pea, or grain of corn, the obstruction will be progressive, owing to swelling through absorption of moisture. Of inorganic materials, the most frequently met with are pins, needles, buttons, coins, and teeth.

The situation and mobility of the foreign body are dependent upon its general characteristics, such as its shape, size, and weight, and the amount of force with which it enters. Statistics show that the most common location is in the trachea, next in the larynx, and lastly, in the right bronchus. The right bronchus is more commonly the seat of obstruction than the left, for the reason that it is the larger and arises higher, and that the septum at the point of bifurcation inclines to the left.

Symptoms.—The symptoms excited by the entrance of a foreign body into the air-passages are—violent convulsive cough, a sense of suffocation, fear of impending death, and pronounced dyspnœa. If the body is retained but does not entirely occlude the passage-way, these symptoms recur with less-

ened severity in the form of a short, harsh cough attended with pain referred to the lower part of the neck, and increased expectoration, which may or may not be bloody. If the position of the foreign body is changed by respiration, the symptoms recur at shorter intervals. The body not being expelled with the subsidence of the symptoms is an evidence of impaction. A foreign body which has been lodged in the air-passage for a considerable period may suddenly give rise to symptoms of obstruction due to displacement from the seat of impaction. The symptoms excited by the presence of an irregular, angular, or sharply-pointed mass are always more severe; the cough is increased, the interval between the spasmodic attacks is shortened, and the pain is more commonly referred to the larynx. In addition to these symptoms there are evidences of inflammatory disturbance, such as elevation of temperature, increased pulse-rate, increased secretion and expectoration, and dyspnœa with pain and tenderness over the seat of lodgement. Symptoms suggestive of incipient pulmonary tuberculosis consequent upon the presence of an unsuspected and impacted body have suddenly abated upon the expulsion or removal of the same. In case of impaction, constant pain, generally located in the upper part of the chest, or a dragging sensation referred to either side of the chest, coupled with the above symptoms, may aid in locating the body. There may be also huskiness of the voice, stridulous breathing, and a cough resulting from deep inspiration, which may be accompanied by mucous or muco-purulent expectoration. If a bronchus be entirely occluded, the lung of the corresponding side may collapse, in which case the normal respiratory phenomena will be absent. As a result of the extension of the inflammation by contiguity, the lungs may become involved, and the character of the expectorated material will be changed, becoming darker and more offensive. Paroxysms of cough, night-sweats, loss of sleep, and great depression will follow and death from exhaustion probably result. When the foreign body is smooth, rounded, and movable, but little inconvenience may be experienced from its presence, and if in the person of a child old enough to describe his sensations, he may complain simply of a feeling of something moving in the windpipe.

Diagnosis.—The character of the symptoms and a careful inquiry into the history of the case will materially assist in forming a diagnosis. In the absence of any history of the entrance of a foreign body, the abrupt onset of symptoms of suffocation in a child previously well is sufficiently significant to suggest the character of the obstruction. Acute laryngitis and croup are conditions which may simulate to some extent obstruction by a foreign body, and may call for careful examination in making a diagnosis. In the case of a foreign body the voice is not necessarily changed unless the offending substance be located in the larynx, in which case there is aphonia; in croup the voice is harsh and high-pitched. In croup or acute laryngitis there is stridulous breathing, which becomes more marked as the case advances; this is not true of a foreign body. In the latter case, the respiratory embarrassment is more pronounced on expiration, while in croup the difficulty occurs on inspiration.

To distinguish obstruction by a foreign body in the air-passage from one in the pharynx or œsophagus, it will suffice to make a digital examination of the pharynx or an exploration of the œsophagus with the œsophageal bougie. In a case of impaction of a partial plate of artificial teeth in the commencement of the œsophagus, where I was obliged to perform œsophagotomy for its removal, the symptoms were believed to be due to its presence in the larynx. The introduction of an œsophageal bougie immediately cleared up the doubt as to location and position in this particular case. As symptoms of respiratory embarrassment and the expectoration of muco-purulent material were present,

it was found at the autopsy that an opening into the larynx had occurred as the result of ulcerative perforation.

While œdema of the glottis may result from the presence of a foreign body, yet it may arise as an independent condition, following injury to the larynx, or the swallowing of chemical irritants of any kind, or it may accompany tubercular, syphilitic, or some other form of ulceration. The diagnosis between foreign body and œdema of the glottis rests largely on the history of the case and upon digital examination, by which is detected swelling of either the epiglottis, the glottis, or of both as the case may be. Further, as mentioned before, the respiratory embarrassment in foreign body is more marked on expiration, while in œdema of the glottis, if seen early, the embarrassment occurs on inspiration only, and in the later stages during both inspiration and expiration.

Laryngeal obstruction associated with lymphatic enlargement of the deep chain of cervical glands gives rise to a series of symptoms, the onset of which are gradual, and consist in the presence of a tumor of slow growth, with some constitutional evidence of a tubercular diathesis. The symptoms of apparent obstruction in this class of cases are not due so much to pressure upon the air-passage as upon the laryngeal nerves.

The advantages to be derived from a laryngoscopic examination in children are practically *nil*, unless anæsthesia be employed, and even under these conditions may prove unsatisfactory. The urgency of the symptoms in the case of a foreign body would contraindicate an examination of this kind in the majority of cases, because the manipulation necessary to accomplish it would be attended by more risk than the operation for removal. In those cases where the immediate symptoms of obstruction subside consequent upon the impaction or the lodgement of the body, an examination may be attempted. Auscultation may be of value in locating the position of the mass, which, if in the larynx, may create rough sounds synchronous with respiration. In connection with the other symptoms of obstruction, if in the trachea, the body may be detected moving with respiration, and even heard to strike against the wall of the windpipe, while, if in a bronchus or one of the bronchial tubes, the normal vesicular murmur upon the corresponding side is absent or modified.

Prognosis.—The presence of a foreign body in the air-passages subjects the patient to great danger. For the first seventy-two hours at least the greatest danger is from suffocation, as the body is liable to be forced into the larynx and cause total obstruction. Thereafter the risk is from hæmorrhage, inflammation, ulceration or abscess, septicæmia, and death from exhaustion. When the substance becomes impacted in a bronchial tube the irritation excited by its presence may involve the parenchyma of the lung, causing a local pneumonia which is sometimes followed by pulmonary abscess. Other organs may become involved through the extension of inflammation by contiguity of tissue—namely, the pericardium, the pleura, and the liver.

Treatment.—All cases of foreign body in the air-passages giving rise to urgent symptoms call for prompt and, in most instances, radical treatment. Nature alone should not be depended upon to expel the offending mass; neither should delay be encouraged in the event of the subsidence of the symptoms, granting that there be no doubt as to its presence. To induce vomiting by the administration of emetics or by mechanical means, is fraught with, to say the least, some risk, and may cause obstruction by impaction in the glottis. If emetics be employed, everything necessary for immediate operation should be in readiness. The practice of inverting the patient and employing succussion with the hope of dislodging the body should be practised only under

exceptional circumstances, and resorted to only when no other means are at hand. This form of treatment, like that by emetics, is open to the objection of danger from immediate suffocation. The class of cases in which either of these means is most likely to prove successful is where the obstruction is due to lodgement of the mass in the pharynx or œsophagus. Here, however, if the body cannot be extracted through the mouth or forced into the stomach by the introduction of an œsophageal bougie, it is not likely that emesis or inversion and succussion will succeed in dislodging it.

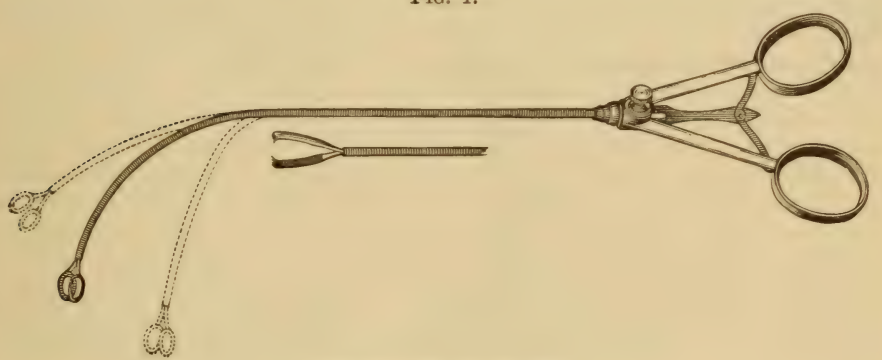
The diagnosis of the presence of a foreign body having been established, the advisability of immediately opening the windpipe, in the event of extraction through the mouth not being feasible, I believe cannot be too strongly urged, as the imminent risk of suffocation is thus removed and the safety of the patient increased. For if the body is not expelled after the windpipe has been opened, impending suffocation is relieved. During the time necessarily consumed in opening the windpipe the respirations, which are already embarrassed, may cease. Should this occur, the operation is to be hastily completed and artificial respiration resorted to. If possible, an anæsthetic, preferably chloroform, should be administered to prevent pain and allay spasm. With the child anæsthetized the surgeon works to a better advantage, both to himself and to his patient. If time is not a factor, the interval between the paroxysms of dyspnœa is the most favorable for operation, as in this period the child is comparatively comfortable, and the operator can work without undue haste. The mere opening of the windpipe does not entail much risk if performed during the period of calm; in fact, less than when done for other conditions. With the extraction of the foreign body the chief source of danger is removed, and if done early the necessity for the introduction of a tracheal tube may not be called for, thus simplifying the case, and lessening, particularly, the chances of post-operative pneumonia.

On the location of the foreign body depends the choice of operation. If diagnosed as occupying the larynx, laryngotomy is advisable on account of its simplicity, the rapidity with which it can be performed, and its affording a more thorough command of the interior of the larynx. If the body is too large to be extracted through this opening, which may be the case in very young children, the space may be enlarged by cutting the cricoid cartilage, and, if necessary, prolonging it into the trachea, making a laryngo-tracheotomy. The entrance of air through this opening may cause the body to be expelled upon expiration through either the incision or the mouth. If the mass is supposed to be located in the upper part of the trachea the high operation is preferable, while if situated lower down in the trachea or in a bronchus the lower operation will be necessary. Occasionally the foreign body, if sharply pointed and impacted, may be detected from without, and then an incision may be carried directly down upon it.

In performing any operation on the air-passages the child should be brought under the effect of the anæsthetic before being placed in the customary position. A free incision should be made in the median line of the neck, and the trachea or the crico-thyroid membrane exposed, as the case may be, by carefully dissecting down upon it. The mistake which I think is often made is that of too small an incision through the skin and fasciæ. A free incision not only affords more room, but gives the operator a better opportunity of recognizing the anatomical landmarks, and of completing the operation with rapidity and safety. In the high operation of tracheotomy the middle lobe (isthmus) of the thyroid gland is to be displaced downward or divided between two ligatures. In the low operation the anomalous position sometimes

held by the vessels must be borne in mind; also the difficulty which may be experienced in dealing with the thyroid plexus of veins. Upon the exposure and division of the tracheal fascia (the last layer of the structures overlying the trachea) air enters between it and the trachea, giving rise to an emphysematous condition by which is occasioned a sound not unlike the entrance of air into the trachea when opened, and this may mislead the operator. A free incision should also be made into the trachea, thus allowing the entrance of a large volume of air, which favors the expulsion of the body. Immediately upon opening the trachea there escapes a frothy mucus or a muco-purulent secretion, depending upon the length of time the foreign body has been present. The tracheal wound should be retracted, when, if the body is not seen or expelled, an attempt to favor its expulsion should be made by exciting cough by irritating the lining membrane with a feather or a camel's-hair brush. If the body be not expelled by either of these means, an attempt to locate and to extract it should be made. Should this fail, inversion and succussion may be resorted to, this practice not being objectionable after the windpipe has been opened. The finger, with well-smoothed nail, undoubtedly offers the best means of locating the foreign body when the size of the windpipe is sufficient. The sensation communicated to it is far more accurate than that obtained through the medium of an instrument. When this manner of procedure is not feasible, the location of the foreign body may be attempted by the introduction of an English catheter without the stylet, a tracheal probe, or the curved laryngeal forceps. The body having been located, its extrac-

FIG. 1.



Durham's Flexible Forceps

tion with a pair of laryngeal forceps should follow; when it holds a transverse position in the air-passage, a blunt hook may facilitate its removal.

If the foreign body be retained, despite all efforts for its removal, a tracheal tube should not be introduced, but the wound in the trachea is to

FIG. 2.



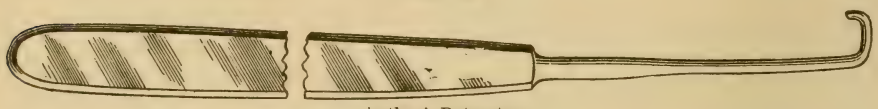
Blunt Hook.

be kept widely open by retractors retained in position; or the edges of the tracheal wound, including the skin and fascia, may be transfixed by sutures, the ends of which are left long and tied at the back of the neck. During

this time the patient must be constantly watched, so that if the body appears at the bottom of the wound, it can be removed. A foreign body in the larynx too large to be extracted through the wound made in the cricothyroid membrane or the windpipe may call for partial or complete division of the thyroid cartilage (thyroidotomy). The propriety of introducing a tracheal tube after operation will depend upon the amount of injury the larynx or trachea has sustained. When the operation is completed without the introduction of a tube, I should advise against suturing the trachea.

If the foreign body occupies a bronchus, its extraction can only be safely accomplished by means of low tracheotomy, and the subsequent use of Durham's flexible laryngeal forceps or a stout flexible wire bent in the shape of a blunt hook. The hope of opening a bronchus through the chest-wall, as a preliminary to extraction, has been clearly demonstrated by experiments upon animals to be both a useless and a fatal procedure, especially in the light of the cases where a foreign body has been expelled from a bronchus several days after the operation of tracheotomy.

FIG. 3.



Author's Retractor.

I would call attention to the retractors I have devised, shown in Fig. 3. They occupy but little space in the wound, are readily introduced, are easily held in position, are out of the way of the operator, and thus afford the best possible means of inspecting the interior of the windpipe.

POST-NATAL ATELECTASIS.

By SAMUEL S. ADAMS, M. D.,

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Post-natal Atelectasis is a condition of the lung in which the once-inflated alveoli become emptied and collapsed from partial or total absence of air in them. It occurs in weakly infants and young children, and varies in extent from a few lobules to an entire lobe or even a whole lung. It is claimed by some that it is a common condition in foundlings and in wasted infants who die during the first year of life.

Etiology.—The predisposing causes of post-natal atelectasis are such as weaken the constitution, whether they operate before birth, as inherited vices, such as syphilis, scrofulosis, malformations, etc.; at birth, as premature delivery or injuries received during parturition; or after birth, as rachitis, improper feeding, neglect, exposure, as in foundlings, unsanitary habitations, and debilitating diseases.

The exciting causes are such as prevent air from entering the alveoli, and permit them to collapse after the residual air has been rarefied, absorbed, or expelled. They may be classified as intrathoracic and extrathoracic. The most frequent intrathoracic cause is bronchial catarrh, more especially of the smaller subdivisions, in which the lumen of the tube is obstructed by the resulting exudation and the ingress of air prevented. Gairdner of Glasgow has explained the mechanical action of a plug of mucus in a bronchiole in gradually diminishing the entrance of air to the area supplied by it, and the resulting collapse of the alveoli. This ball-valve shuts out the air at every inspiration, but allows the expulsion of that within the alveoli. If this obstruction be not displaced, the pressure exerted by the atmosphere upon the thoracic walls and the contractile force of the pulmonary tissues cause the alveoli to collapse. It may also be caused by whooping-cough, the paroxysms expelling the residual air and decreasing the power of the inspiratory forces. Measles is cited by some as an etiological factor, but the more immediate cause is probably the attendant bronchial catarrh. Effusion into the pleura or pericardium may cause collapse of the pulmonary alveoli in varying degrees proportionate to the pressure exerted by the fluid and the resistance of the lung. The lodgement of foreign bodies, as beans, peas, seeds, or metallic or porcelain substances, in a bronchus may prevent ingress of air and lead to alveolar collapse.

Among the extrathoracic causes are spinal curvature, deformity of the chest-wall, constricting clothing, and solid or fluid tumors in the abdominal cavity. Any one of these might be sufficient to compress the lung to the degree of collapse by diminishing the capacity of the thoracic cavity. It may also be of cerebral or spinal origin. Disease of the brain, cord, or nerves which paralyzes or over-stimulates the respiratory centres or prevents the transmission of nerve-force may produce atelectasis by impeding the inspiratory or increasing the

force of the expiratory muscles of respiration in a weakly or rachitic infant. Finally, it may originate independently of affections of the air-passages, as from the exhaustion of long-continued illness, constant dorsal decubitus, diarrhœa, or ileo-colitis.

Pathology and Pathological Anatomy.—Post-natal atelectasis, unlike the congenital form, is a pathological condition in which the expanded lung-alveoli return to the ante-natal state, from arrest of function owing to some mechanical impediment to the ingress of air. The extent of the collapsed area is either circumscribed or diffused, depending upon the calibre of the obstructed bronchus. It is usually situated at the postero-inferior margin of the lung parallel to the spinal column; or it may involve a whole lobe or a whole lung. When it complicates bronchial catarrh, it occurs in small, scattered areas, corresponding to the ramifications of the obstructed bronchus. In pericardial and pleuritic effusions of moderate extent the lower lobes are involved, but if the exudation is abundant the entire lung may be collapsed from compression.

The atelectatic lung-tissue, being devoid of air, is shrunken, depressed below the level of the surface of the lung, is of irregular outline, and dark-brown, violet, or reddish-blue in color. On section the collapsed tissue appears dark-red and smooth, and a serous or bloody fluid exudes from it. From its resemblance to flesh it is called "carnification." It is firm, dense, tough, without crepitation, airless, and sinks in water. If the collapse be recent, the alveoli can be re-inflated by removing the obstruction and blowing into the bronchial tube. If bronchial catarrh be present, the mucous membrane is swollen, soft, and hyperæmic, and the tube is filled with thick, tenacious muco-pus forming a complete plug. Around the affected areas are air-vesicles in a state of compensatory dilatation. This physiological emphysema is only found when the child has had sufficient strength to increase the inspiratory efforts, and is but rarely seen in the feeble.

Symptoms.—The atelectatic areas may be so small, so scattered, or so obscured by the adjacent compensatory emphysema as to be wholly overlooked, although frequent and careful physical examinations may be made. This is especially true of cases in which there is no recession of the chest-wall, and where the neighboring alveoli are so distended as to increase the vesicular murmur and intensify the percussion resonance.

As post-natal atelectasis usually happens to emaciated and puny infants, the general symptoms vary according to the extent of the lesion. In mild cases the infant is indifferent to its surroundings, gives vent to a whining expiration, is slightly cyanosed, and refuses its nourishment; but these symptoms quickly disappear upon the dislodgement of the occluding mucus plug. In severe cases restlessness and sleeplessness are well marked; there is evidence of distress and exhaustion depicted upon the face: the features are pinched; the eyeballs are sunken and without shimmer, and the livid eyelids droop; the mouth is drawn and the lips are livid: and the head and face are bathed in a profuse, cold, clammy perspiration. The tongue is dry, swollen, and purple; the appetite is lost, the infant refusing to nurse, suck the bottle, or take food from a spoon: the bowels are normal, unless there be some gastro-intestinal derangement. Collapse is often rapid and pronounced, but is not always fatal. There may be convulsions, in one of which the infant may die, though they are not necessarily fatal. The pulse is accelerated and small, and its tension decreases as the atelectatic area increases. Cough, though not always present, is due to bronchial catarrh. The integument is dusky, and becomes livid and clammy as the disease progresses. The temperature is normal or subnormal even when atelectasis occurs during the course of a febrile disease.

Physical Signs.—It is not surprising that this disease is so frequently confounded with pneumonia, when we remember that its physical signs are indicative of more or less consolidation of lung-tissue, with a catarrhal inflammation of the bronchial mucous membrane. So the physical signs vary with the extent of tissue involved.

Inspection.—The nares dilate with the respiratory movements, which are superficial and rapid, varying from 60 to 90 per minute, and their normal ratio to the pulse is lost. Inspiration is slower and more labored than expiration, and is followed by a pause. Retraction of the chest-wall varies with its elasticity and the extent of the collapsed lung beneath. If a considerable area of lung is involved, the chest-wall yields to atmospheric pressure, resulting in depression of the supraclavicular and intercostal spaces, with a deep furrow over the affected area. The deformities of the chest-wall are exaggerated if spinal curvature or rachitis exists.

Auscultation.—The vesicular murmur is feeble or absent unless there is compensatory emphysema around the atelectatic areas. Bronchial respiration and bronchophony are present when a large collapsed area surrounds a bronchus. When fine crepitant râles are present, they indicate an extension of the catarrhal process to the neighboring bronchioles and alveoli.

Percussion.—Dulness is usually found at the base of the lung posteriorly, but is often slight or entirely absent, and if the neighboring alveoli are emphysematous the percussion resonance may be greatly exaggerated. The dulness may extend upward parallel with the spinal column; it may remain stationary, or it may be transient or change with the position of the infant. If it is due to compression from a collection of fluid in the pericardial, pleural, or abdominal cavity, the signs of this causative factor may be defined.

If it is coincident with bronchial catarrh, whooping-cough, diarrhœa, typhoid fever, or any exhausting ailment, the symptoms of the primary affection will be present.

Duration.—The duration of life is uncertain, and in some infants it is surprisingly long. Some die very early from asphyxia or in a convulsive attack, while others linger for weeks or months to die of slow asphyxia or exhaustion.

Diagnosis.—If the atelectasis is in scattered areas, it is seldom recognized, and even if large areas are involved, it may be overlooked unless frequent and careful examinations are made. It is most common in the feeble and emaciated infant, and is directly caused by some disease which impedes the respiratory movements. It frequently accompanies broncho-pneumonia, pertussis, measles, or some long-continued and exhausting disease. The respirations are rapid and shallow, dyspnœa is progressive, cyanosis marked, and exhaustion increasing. Auscultation reveals an absence of vesicular breathing and the presence of bronchial respiration and bronchophony, and there is dulness on percussion over the affected area. A differential diagnosis is generally difficult, owing to the similarity of post-natal atelectasis to other diseases. Some of the physical signs of croupous or broncho-pneumonia are often observed in atelectasis, but the characteristic general symptoms of these two diseases are either indistinct or absent. In pneumonia the temperature is high, and is frequently accompanied by delirium or convulsions; the pain is acute; the face is flushed; the skin is hot and dry; there are fine crepitant râles and percussion dulness over a large area; and retraction of the chest-wall during inspiration is absent. In atelectasis there is a normal or subnormal temperature; pain is absent; the face is livid; the skin is cold and wet; râles are

only present when bronchial catarrh exists; dulness is in small scattered areas; and the chest-wall retracts during inspiration.

While it is possible to confound atelectasis with acute miliary tuberculosis, still there are so many well-defined symptoms, as the previous history, cough, great fluctuation of the daily temperature, emaciation, and exhaustion, which precede the stage of solidification in tuberculosis, that the differentiation should be made with a degree of certainty.

Atelectasis should not be mistaken for pleuritic effusion, as the absence of bronchial breathing, bronchophony, and vocal fremitus, taken in conjunction with the alteration of the line of dulness with the changing position of the patient, will settle the diagnosis. In doubtful cases aspiration would be the determining factor.

Prognosis.—The prognosis is always grave, and recovery is extremely rare, owing to the low vitality of the infant. If it complicate bronchial catarrh or broncho-pneumonia in a puny, rachitic infant, atelectasis is fatal. Convulsions greatly jeopardize life. If somnolence, increasing cyanosis, superficial and hurried respirations, and refusal to take nourishment supervene, the prognosis is unfavorable; but if intelligence return, cyanosis disappear, the respirations become stronger and deeper, and the child take nourishment liberally, the chances are favorable to recovery.

When complicated by whooping-cough, general pulmonary emphysema, broncho-pneumonia, tuberculosis, or pleurisy, it is fatal. When caused by compression, as in hydro-, pyo-, or pneumo-thorax or tumors, the prognosis depends upon the removal of the cause. When dependent upon the presence of a foreign body in a bronchus, recovery is conditioned upon its dislodgement. It must be remembered, however, that in some cases the infant may recover from the immediate effects of atelectasis to die later of cheesy pneumonia or phthisis.

Treatment.—This being a disease which is superinduced by the lack of resistance of the enfeebled infant, the prime factor in the treatment is to improve the general health so as to enable it to repel all causes that depress the vitality. To this end personal and domiciliary hygiene should be carefully regulated. In seasonable weather the infant should be taken in his perambulator into the open air; removal into the country, or, when practicable, to the mountains or seashore, is advisable. An occasional tepid, alcoholic, or moderately cool sponge-bath will prove beneficial. Sleep should be encouraged at stated times, care being taken not to permit too much. The clothing must be of the proper quality and quantity, and should permit of the freest movements of the chest. Very feeble infants may be wrapped in cotton-wool. The domicile must be scrupulously healthful in having pure air by free ventilation and the best sanitary equipment. The temperature of the room must be from 70° to 75° F.

Care should be taken in supervising the quality and quantity of the infant's food. If the nursing infant has progressively emaciated and weakened, the mother's milk needs attention. If bottle-fed, the management is even more perplexing, but the proportion of albuminoids, fat, and sugar can be changed until a combination is found that will be digestible and nutritious. Broths and beef-juice may prove valuable adjuvants to the milk diet. If the infant be too weak to nurse, or even to swallow, gavage or stomach-feeding is indicated. When the stomach will not retain food, the strength must be sustained by concentrated nutritious enemata.

There are no specifics for the cure of atelectasis, but its different phenomena must be met promptly and energetically. When secondary, the treatment must be directed to the primary affection. If a foreign body be lodged in a bronchus,

its removal by operation is recommended. If the obstruction is a plug of ropy muco-pus, it may be removed by active emesis induced by teaspoonful doses of syrup of ipecacuanha, one or two grains of the sulphate of copper dissolved in water, or the hypodermatic injection of apomorphia.

Cardiac and respiratory depressants, especially preparations of opium, must be positively interdicted, while cardiac and respiratory stimulants must be judiciously administered. The cardiac stimulants of most importance are strophanthus, sparteine, nitro-glycerin, camphor, musk, and ammonium carbonate. Brandy, in frequently repeated doses, is one of the most efficient stimulants. The force of the respiratory movements can be increased by $\frac{1}{300}$ to $\frac{1}{200}$ grain of atropine sulphate, which stimulates the respiratory centre. Compressed air or oxygen may be inhaled, but neither has proved to be particularly beneficial. Convulsions must be treated by hot mustard baths and antispasmodics. Finally, to ensure any hope of success, the infant requires the most careful handling, the most rigid regimen, and the most judicious dosage.

BRONCHO-PNEUMONIA.

By WILLIAM PEPPER, M. D.,

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Broncho-pneumonia—also known as catarrhal pneumonia, lobular pneumonia, and capillary bronchitis—is an inflammatory disease of the terminal bronchioles and air-vesicles of the lung, affecting scattered groups of lobules. Though in the main a catarrhal inflammation of the bronchioles and air-sacs, the interventricular and peribronchial tissues are also involved, and the term "catarrhal pneumonia" is therefore not altogether accurate, nor are the other terms by which it has been designated wholly appropriate in all cases. The disease varies widely in its course and duration, often proving fatal in a few days, at other times becoming a lingering chronic affection, leading to secondary changes or creating a tendency to subsequent tuberculous infection.

Etiology.—Broncho-pneumonia is in the great majority of cases a secondary disease, and, as a rule, bronchitis is the primary cause. This may be either a simple bronchitis or that which occurs as a part of infectious diseases, prominent among which are measles, whooping-cough, diphtheria, influenza, and typhoid fever. The manner in which a bronchitis affecting the smaller tubes might lead to a broncho-pneumonia is readily appreciated, but will be considered more minutely in the description of the morbid anatomy. A most important cause is tuberculosis affecting the bronchi and lungs. In all cases of chronic phthisis there occur from time to time attacks of localized broncho-pneumonia, from which the patient recovers, or there may be more widespread and fatal attacks. The primary focus of tuberculosis is sometimes so small as to have escaped detection, and in such cases the broncho-pneumonia is apt to be looked upon as of the ordinary type. Broncho-pneumonia may also arise without bronchitis as a primary disease of obscure origin, or as a result of inspiration of irritants from the mouth, nose, or upper respiratory passages, and in the new-born it may be the result of respiration of the liquid secretions of the genital tract during birth.

The specific cause of the inflammation is probably, in most cases, the pneumococcus of Fränkel, but the staphylococcus and streptococcus pyogenes, the bacillus of Friedländer, or, as we have seen, the tubercle bacillus, may be the excitant in certain cases.

Of the predisposing causes of catarrhal pneumonia, by far the most important is the age of the patient. A study of mortality statistics of young children shows pneumonia to be second only to infantile diarrhœa as a cause of death, and in children under five years it is the lobular form of pneumonia which is found in the great majority of cases. It is especially during primary dentition that broncho-pneumonia occurs, and most of the fatal cases in particular occur before the age of two years. The preponderance of this form of pneumonia during the early years of life is to be explained partly by the anatomical condition of the lungs, and partly by the marked tendency to catarrhal processes generally in infants.

In addition to age, malhygienic surroundings exercise a powerful influence on the prevalence of the disease, and particularly is this the case in times of epidemics of measles, diphtheria, and whooping-cough, when children of the poorer class are especially exposed and are apt to suffer from improper care. The disease is most common during the winter and spring, and particularly at times when the weather is changeable. Previous conditions of health, aside from the infectious diseases, exercise some influence, and children suffering with rickets or scrofula are prone to be attacked by the disease in its most fatal form.

Morbid Anatomy.—As stated before, the more important part of the pathological changes is the catarrhal inflammation of the lining of the smaller bronchioles and air-vesicles, the epithelial cells rapidly desquamating and accumulating within. As a rule, the cells are cast off singly, and lie intermingled with a smaller number of leucocytes or red corpuscles. In more rapid and virulent cases the epithelial lining may be detached in large flakes, and sometimes there is considerable diapedesis of red blood-corpuscles, giving the section a decidedly hæmorrhagic appearance. The latter, however, is rare. As the disease continues the cellular desquamation and exudation increase, and at the same time a more or less copious outpouring of mucous secretion occurs, until the bronchioles and air-vesicles become completely filled. Beginning in the terminal bronchi, the inflammatory process advances, and invades the adjacent air-vesicles in several ways. In the first place, there is always a direct extension of the inflammation to the surrounding peribronchial tissues, which are seen to be invaded by round cells and to be the seat of active cellular proliferation. The secondary peribronchial inflammation gradually spreads to the walls of the adjacent air-vesicles. Thus it is seen that the peribronchial and perivesicular involvements are important elements in the morbid anatomy, and in cases where the disease becomes chronic these secondary changes lead to the induration processes characteristic of chronic broncho-pneumonia. The extension from the bronchioles to the alveoli is, however, also effected in other ways. There may be a continuous inflammation extending along the epithelial lining, or the irritating matters within the tubes may be directly conveyed by the strong inspiratory efforts following a paroxysm of coughing. These inspired substances may directly excite vesicular inflammation, or by obstructing the terminal bronchial tubes may first produce areas of collapse of the lung-tissue. The occurrence of pulmonary atelectasis in the course of bronchial catarrh and broncho-pneumonia is entirely a mechanical result of the obstruction of the tubes. In some cases the obstructing material acts as a ball valve, permitting the air to pass out, but not re-enter the affected area. More frequently the expiratory efforts expel the air through partially obstructed tubes, but the weaker inspiratory force proves inadequate to refill the vesicle; and finally, in cases where there has been complete obstruction of the tubes, the air enclosed within is gradually absorbed. In any case, the vesicular structure collapses, the blood-vessels become surcharged with blood, and the most favorable conditions for inflammatory action are thus supplied.

When the disease begins to undergo resolution the cellular material within the vesicles suffers fatty degeneration, and with the mucous secretion is expectorated or absorbed coincidently with resolution of the peribronchial inflammation. In cases, however, in which chronic pneumonia results, the peribronchial connective-tissue hyperplasia undergoes fuller organization, and induration follows in consequence. The bronchial walls are thickened, and

not rarely show fusiform dilatations, the result of traction of the newly-formed connective tissue.

The macroscopic appearance is highly characteristic in most cases. The involvement of scattered lobules of both lungs in itself is a most distinctive condition, though sometimes by confluence a whole lobe may be affected. In such cases the distinction from croupous pneumonia becomes one of great difficulty if, as sometimes happens, the vesicles contain fibrinous exudate and the incised surface presents a granular appearance. Even in these cases, however, it will be noted that the process is not entirely a uniform one, and that there is a certain tendency to lobular limitation. Examination of the pleural surface of the lung shows a moderate deposit of lymph over areas which have reached the periphery. The inflamed lobules project slightly from the surface, and have a dark-red or in later stages a grayish appearance, which at once distinguishes them from the depressed, blue-black, and indurated spots of atelectasis. The latter may be small and lobular or more extensive, and they are most frequently seen posteriorly along the spinal column or anteriorly in the middle lobe of the right lung or the lingula of the left. In the early stages they may usually be distended by inflating the lungs through a tube, but later, as inflammatory changes occur within them, this becomes difficult or impossible. The incised surface of the lung presents a similar picture. The distinct lobular invasion is again quite evident, and the atelectatic areas are recognized by the same characters as on the pleural surface. The lung is smooth and airless in the affected portions, or in rare cases may be slightly granular when the exudate contains fibrin. The smaller bronchi are distended with clear viscid mucus or turbid yellowish muco-pus. The lobules adjacent to the affected ones are emphysematous, as are also the anterior margins and the upper lobes of the lungs, and occasionally subpleural emphysema may be seen. In one instance I found pneumothorax resulting from rupture of the pleura in such a case.

When resolution takes place, the inflamed lobules become lighter in color, the exudate softens, and is finally removed. More rarely abscess or gangrene may result, or chronic broncho-pneumonia may occur in lingering cases. The termination in cheesy pneumonia, of which much was formerly written, is perhaps always the expression of tubercular infection, either primary or consequent upon the broncho-pneumonia.

Symptoms.—The onset of broncho-pneumonia is rarely marked by decided symptoms. If the primary measles or whooping-cough has not been entirely recovered from, a slight increase of the existing fever, with acceleration of the pulse, dyspnœa, and a change of the cough to a short and hacking character, may be the only symptoms to indicate beginning trouble. In cases in which broncho-pneumonia arises primarily the same symptoms follow an initiatory stage of bronchitis. The fever rises gradually, reaching the maximum in three or four days, and is throughout the disease markedly irregular, the diurnal excursions ranging from three to four degrees. In ordinary cases the evening maxima are from 103° to 104.5° F., but it is not unusual to find higher temperatures, and in one case which recovered I have seen it reach 107°. The decline of the temperature, like the ascent, is gradual, and for a long time during convalescence feverishness may be noted toward evening. With increase of the fever the pulse-rate accelerates to 130 or 140 beats per minute, and in exceptional cases a rate of 200 may occur. Dyspnœa, however, is a more decided symptom, the ratio between the respiration and pulse not infrequently becoming 1 to 2, or even less than 2. The alæ of the nose dilate with each inspiratory effort, the base of the chest sinks in, and the child mani-

fests by its expression that pain is felt in the side. When areas of the lung collapse, there are paroxysms of more decided dyspnœa, the expiration becomes more grunting, and duskiness or decided cyanosis of the skin makes its appearance. The cough at first is sharp and short, and is attended by grimaces and a cry of pain; later it is heard to be looser, and in children over seven years of age there may be muco-purulent expectoration. In younger children the

FIG. 1.

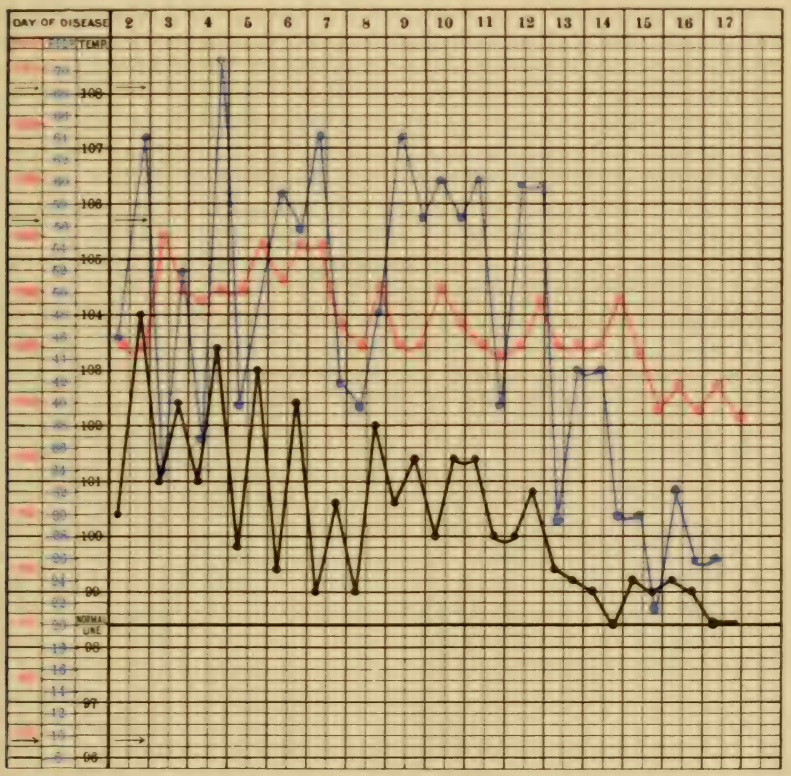


Chart of Temperature, Pulse and Respiration of Broncho-pneumonia in a patient two years and two months old; recovery.

sputa are swallowed. With the fever and dyspnœa there is nearly always a complete loss of appetite, but excessive thirst. Nursing infants are unable to retain hold of the nipple for more than a moment or two on account of dyspnœa, and older children refuse food entirely. The child becomes fretful and irritable, but sometimes the urgency of dyspnœa may be such that it suffers itself to be taken up or examined without complaint. The general strength rapidly declines, and, as the interference with respiration continues, a soporose or somnolent condition or complete stupor presages an early death unless relief be afforded. Not infrequently vomiting is present at the onset or during the course of the disease, and with diarrhœa may still further add to the general depression and the unfavorable outlook.

In cases in which resolution occurs the symptoms gradually ameliorate, the fever subsides, and in the course of a few days or a week convalescence is established. In less favorable cases, after subsidence of the urgent symptoms, the disease may linger and become chronic, or from the start it may assume a

chronic type. In such cases there is persistent, irregular pyrexia, with cough, dyspnœa, and acceleration of the pulse, and the general health of the patient becomes more and more depressed.

Physical Signs.—At the inception of the disease the physical signs of bronchitis affecting the smaller tubes will nearly always be present. At first there are heard on auscultation numerous dry râles throughout both lungs; later, coarse moist râles make their appearance, but the pulmonary resonance remains unaffected. The physical signs of the developed disease are by no means distinctive. Defective expansion and an up-and-down type of breathing are manifest, and with each inspiratory effort the base of the chest may be seen to recede. At the same time, careful percussion of the lateral and posterior portions of the lungs may detect localized patches of dulness, but this is by no means constantly the case. In not a few the percussion note is hyperresonant, perhaps from associated emphysema of the unaffected lobules, or, on the other hand, the extent of dulness is rendered considerable by coexistence of large areas of atelectasis. Vocal fremitus is slightly increased over the consolidated areas when the bronchial tubes are not unduly filled with mucus, but over the collapsed portions it is usually wholly absent. Auscultation shows the continuation of the preceding bronchitis, but in addition to these coarser dry and moist râles there is also heard fine moist crackling over the consolidated areas. These fine subcrepitant râles are heard on inspiration and expiration, and are perhaps the most suggestive sign of the disease. The breath-sounds themselves vary widely with the condition of the terminal bronchi and the degree of distention. Sometimes the sounds are weak and faintly blowing, at other times harsh and clear, but only rarely do we find the distinct bronchial breathing of croupous pneumonia. It will be noted, then, that the signs of broncho-pneumonia are in no sense characteristic; but when to the râles of bronchitis there are superadded fine subcrepitant râles, with harsh or somewhat blowing breathing, and areas of even indistinct impairment of resonance at the postero-inferior portions of the lungs, the evidence is fairly clear as far as physical examination is concerned.

Complications and Sequels.—As has been said in the description of the pathological anatomy, pulmonary collapse is a more or less constant factor in the disease, and is therefore hardly to be looked upon as a complication. Yet in some cases the extent of the atelectatic areas is so great, and the attending dyspnœa and appearance of suffocation so severe, as to merit the place of complicating symptoms. It is in such cases that the old title "suffocative catarrh" finds a not inapt application. Pleurisy, so commonly present in slight degree, rarely becomes a troublesome complication, though some observers, among them myself, have met with purulent effusion. Abscess and gangrene rarely follow broncho-pneumonia, but are most apt to do so in aspiration and deglutition pneumonias, in which the inflammation from the beginning may take on a serious character. Subpleural emphysema and pneumothorax are rare complications. The most dreaded sequel of broncho-pneumonia is tuberculosis. In some of the cases the broncho-pneumonia is undoubtedly tubercular from the beginning, but in any case the vulnerability of the system is so heightened by the attack that subsequent infection becomes an easy matter, and frequently occurs. The marked nervous symptoms during the course of broncho-pneumonia or toward its termination may suggest meningitis, but it is more probable that in the majority of such cases the symptoms are due to hyperæmia of the meninges or the toxæmic state of the patient rather than to actual meningitis.

The termination of protracted cases in chronic pneumonia has been alluded to before.

Diagnosis.—In the first place, it is essential to recognize the development of pneumonia during acute bronchitis at the very earliest moment. It may be suspected when there has been a sudden increase of fever and acceleration of the pulse and respiration, but such might occur independently of broncho-pneumonia. If, however, in addition to these symptoms, fine subcrepitant râles and blowing breathing be heard, and percussion detects small areas of impairment of resonance, pneumonia may be diagnosticated with considerable certainty.

The disease when fully developed may readily be confounded with croupous pneumonia in cases in which the confluence of lobular involvement has led to a considerable area of consolidation. This, however, is rarely the case, and even when it does occur the consolidation is not so definitely localized in one lobe, and scattered patches will probably be found in the other lung. In ordinary cases the dulness, the vocal fremitus, and bronchial breathing are not developed to nearly the degree which they commonly attain in croupous pneumonia, and in typical cases there could scarcely be the possibility of confounding the one disease with the other. The difficulty, however, of making accurate physical examinations in young children is often considerable, and in such cases the history of the disease is of greatest assistance. The gradual onset and the marked irregularity of the fever, the existence of a preceding bronchitis, and the character of the sputa when present, are in all cases highly suggestive of broncho-pneumonia, as the abruptness of the attack and the greater regularity of the temperature curve give strong evidence of croupous pneumonia.

The diagnosis from pleurisy with effusion presents little difficulty, altogether aside from the fact that the latter disease is rare in children under six years. The coexistence of moderate pleuritic effusion may, however, be difficult to recognize. In such cases the decided dulness and the variation of its outlines with changes in the position of the patient, and the more distant and muffled character of the breath-sounds, may serve to indicate the actual pathological conditions; but the complication so rarely occurs that its recognition hardly merits further study. More commonly, plastic pleurisy accompanies broncho-pneumonia, and may confuse the physical signs, but careful study of the degree of dulness, compared with the auscultatory phenomena, will in these cases usually point to the proper diagnosis, and the evidence of great pain in the side would still further strengthen this opinion.

In cases in which nervous symptoms or gastro-intestinal disorders become prominent, it may happen that the underlying pneumonia is wholly overlooked. Such an error can only be avoided by a critical study of the symptoms in every case, particularly by close observation of the rate of the pulse and respirations and by careful and repeated examination.

Prognosis.—Broncho-pneumonia is always a most serious disease, the mortality ranging from 30 to 50 per cent., according to the nature of the cases and the surrounding conditions. It is most fatal in children under two years, and the form which occurs in the new-born from aspiration of irritating or infectious particles during the transit through the maternal passages is almost invariably fatal. In children over two years of age the mortality grows progressively less with the age of the patient. The cases which complicate whooping-cough are most apt to be fatal or lingering. Rickets or other debilitating diseases and the occurrence of gastric disturbances, diarrhœa, marked nervous symptoms, and pyrexia, all make the prognosis highly unfavorable.

Duration.—The duration of ordinary cases is generally from fifteen to twenty-five days; milder cases may terminate in a week or ten days. Chronic

broncho-pneumonia is uncertain in duration, ranging from a few to many months.

Treatment.—It is difficult to lay down fixed rules for treatment in a disease in which so much depends upon the actual extent and nature of the pathological changes and upon the reaction of the patient.

In many cases of bronchitis or of infectious diseases attended with bronchitis, it will be possible to prevent the development of broncho-pneumonia by careful attention to hygiene and by strict insistance upon every detail of treatment. It will be necessary in such cases to maintain an even temperature of 70° or 72° in the sick-room, to avoid all drafts, and to adapt the clothing of the patient according to his powers of resistance. In very young children the mouth should be carefully cleansed with some simple mouth-wash like glycerin and boric-acid solution, and older children should in addition be directed to expectorate the sputa.

When pneumonia has actually become established, the hygienic details of the sick-room must be still more strictly maintained. The temperature of the room must be kept as nearly as may be at an even point, and it is always well to have the air moistened by allowing water to steam at the hearth or over a flame. In severe cases a tent of sheets may be erected over the bed and steam from a boiler be directed into it. A light woollen shirt should be worn, and the chest will require special protection. Formerly flaxseed poultices were in common use in the treatment of pneumonia, but they are so apt to become cold and disordered, and their constant application is attended by so much risk and disturbance of the patient, that their use is now generally abandoned. The best protection is afforded by a jacket of cotton or wool batting, lightly quilted and covered on the outside with oiled silk. This may be so constructed as to be easily applied and removed without the slightest disturbance of the patient, and it is so light as to cause little discomfort by its weight. Practically the same thing is accomplished by stitching cotton batting on the inside of a light merino shirt, and oiled silk outside, but the jacket is more convenient. It is unnecessary in ordinary cases to change the jacket oftener than every seven or eight days. The use of counter-irritants, such as turpentine stupes, mustard plasters, and blisters, while occasionally advisable, has, as a routine treatment, fallen into disrepute: but the repeated application of tincture of iodine diluted with alcohol, so as not to prove too irritating, is often attended by good results.

The diet of the patient should be at once light and nutritious, so that the digestive functions may be kept in the best possible condition, and at the same time the patient's strength preserved. Milk, gruels, light broths, arrowroot, and egg albumin dissolved in water or milk answer the requirements, and are the most suitable foods obtainable. In addition to proper regulation of the diet, it is sometimes desirable to administer a mild laxative at the onset or during the course of the disease if constipation be present: but it must be remembered that gastro-intestinal irritation is apt to complicate the case, and nothing must be done which might invite its occurrence. Minute doses of mercury with bicarbonate of sodium or Dover's powder, or the mildest salines, may be of value, and in certain cases may exercise a happy regulating influence on the gastro-intestinal system, provided that free purgation is not induced.

For the condition of the lungs themselves expectorants are highly important. During the early stage, when bronchitis is marked and the sputa tenacious, small doses of ipecacuanha or apomorphine, in combination with alkalies like citrate of potassium, are useful. Such a combination as the following is readily taken by children, and rarely fails to render the mucous secretion less tenacious:

℞. Potassii citratis . . . . . ʒiiss.
Syr. ipecac. . . . . fʒss.
Syr. limonis . . . . . .
Aquæ . . . . . *āā* q. s. ad fʒiv.—M.
Sig. Two teaspoonfuls every three or four hours, for a child of five years.

A small dose of apomorphine—a sixteenth or a twenty-fourth of a grain—may be added with advantage in case the mucus is unusually tenacious. Generally, however, recourse must soon be had to the more stimulating expectorants. The ammonium salts, the chloride and carbonate, in combination with squills or senega, are the most desirable. In cases in which depression is marked the carbonate is preferable to the chloride, and when painful cough is urgent minute doses of morphine or paregoric may be added to the mixtures. Opium, however, should never be given with such freedom as to benumb the sensibility, and in the later stages of the disease should be avoided if possible. In some cases, where the stomach is particularly irritable, the aromatic spirits of ammonia may be better retained than other preparations, and is acceptably administered in combination with brandy or other stimulant.

The following combination is especially valuable for children, being pleasant to take and more stimulating than such as contain the chloride of ammonium:

℞. Ammonii carbonatis . . . . . gr. xlviij.
Pulv. acaciæ et sacchari . . . . . *āā* q. s.
Spt. lavandulæ comp. . . . . fʒij.
Aquæ . . . . . q. s. ad fʒiv.—M.
Sig. A teaspoonful in water every two or three hours, for a child five years old.

The general strength of the patient, and particularly the respiratory function, require special attention. To this end quinine in small doses and alcoholic stimulants are highly beneficial, but for respiratory and muscular stimulation no drug compares with strychnine in efficiency. E. g.—

℞. Quininæ sulph. . . . . gr. xxiv.
Strychninæ sulph. . . . . gr. ¼.
Acid. muriat. dil. . . . . gtt. xvj vel gtt. xxxij.
Glycerini . . . . . fʒiij.
Liq. pepsini . . . . . q. s. ad fʒiv.—M.
Sig. A teaspoonful in water every three or four hours, alternating with the expectorant remedies, for a child of five years.

In cases where the stomach is non-retentive quinine may be given in suppositories of two or three grains each. The use of such expectorant and tonic treatment usually suffices to keep the bronchi free and to prevent the occurrence of atelectasis; but when these unwelcome accidents make their appearance and suffocating paroxysms occur, active treatment must be instituted. The administration of emetic doses of ipecacuanha, five grains of the powder in a little syrup, is an old method of treatment which serves admirably to clear the respiratory passages. In some cases it may be well to combine alum or sulphate of zinc with the ipecacuanha, but the preparations of antimony formerly so commonly used are depressing agents which had better be avoided. When vigorous emesis fails of the desired purpose, a warm bath or alternate hot and cold douches may be resorted to, and stimulants given by the mouth and

hypodermatically. In all cases in which the strength of the child is greatly affected it is necessary to change the position from time to time, so that hypostatic congestion may be avoided.

Fever in catarrhal pneumonia does not usually call for active treatment, from the fact that the pyrexia is not constantly maintained at a high point, but such is not always the case. In the very early stages a few doses of the tincture of aconite, a half or one drop repeated every hour or two, are of distinct value; and in the later stages small doses of antipyrin or phenacetin exert a powerful influence on pyrexia. The use of either aconite or more active antipyretics must always be most cautious, and the first indication of general depression would call for the immediate withdrawal of the medicines. Unquestionably the use of hydrotherapic measures is most valuable in controlling fever, in stimulating the general and respiratory tone, and in quieting the nervous system. The patient may be carefully sponged with lukewarm or cold water or wrapped in sheets wrung out in water, or he may be placed in a bath of temperature varying according to the age. With very young children the temperature of the water should be near that of the body, and gradually cooled after the patient has been placed in it; in older children the initial temperature may be 85° or 80°. After removal from the bath the skin should be lightly dried with a towel or woollen cloth and the patient wrapped in a blanket.

Excessive nervous symptoms are to a large extent controlled by sponging or bathing, but in cases where this is inadequate small doses of chloral may be given in enemata, or asafœtida in 5 grain doses, may be added to the quinine suppositories.

In more chronic cases the general health and the respiratory action should be maintained by the closest attention to daily life and by administration of suitable tonics.

During convalescence of acute cases renewed exposure must be avoided, and the child should receive cod-liver oil, arsenic, iodide of iron, or other tonics; and, if possible, a change of climate is of material advantage.

CROUPOUS PNEUMONIA.

By WILLIAM PEPPER, M. D.,

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Croupous Pneumonia—designated also lobar pneumonia and fibrinous pneumonia—is a specific inflammatory disease of the lungs, characterized by fibrinous exudation into the vesicular structure and consolidation of the lung, presenting a characteristic clinical course and terminating by self-limitation in seven to ten days. The croupous pneumonia of children differs from that of adults only in some of the less important manifestations, in the situation of the lesion, and in the smaller mortality.

Etiology.—One of the most important causes of croupous pneumonia is exposure to cold. The history of a large majority of the cases will disclose the fact that the child has suffered chill from exposure, and the study of mortality statistics shows that two-thirds of all cases occur during the winter and spring. Cold cannot, however, in the light of recent knowledge, be looked upon as the exciting cause of the disease, though there are still some who maintain that a small number of idiopathic cases from exposure do exist.

Age is an important factor in determining the form of pneumonia. The croupous variety, though it does sometimes occur in infants at the breast, is rare before the age of three, and in children is most common between five and ten. On the other hand, broncho-pneumonia is a prevalent disease in children under three or two, its frequency being explained by the great tendency to catarrhal processes manifested in young children.

The previous health of the child is another point in which the croupous form differs from broncho-pneumonia. Unlike the latter, it affects children who are robust and in good health. Rilliet and Barthez said that in only one-quarter of the cases was the child in good health before, but this may have arisen from confusion with broncho-pneumonia, and in the statistics of private practice of Dr. J. F. Meigs and myself there were but 7 of 52 cases secondary to previous diseases. Of the diseases upon which croupous pneumonia may be consequent, pulmonary tuberculosis, measles, whooping-cough, influenza, and typhoid fever may be named; but in all of these in children under three years of age broncho-pneumonia is more apt to occur as the complication.

Malhygienic influences may induce pneumonia, either by causing exposure or by reducing the power of resistance in some other manner.

The exciting cause in a great majority of all cases is the pneumococcus of Fränkel. This lance-shaped coccus usually occurs in pairs as a diplococcus, and is surrounded by a transparent capsule. It has been found in a very large percentage of cases of croupous pneumonia, but also in the catarrhal form, and it seems to bear close etiological relations also to cerebro-spinal fever, to middle-ear disease, and to endocarditis. The pneumococcus is a normal constituent of the saliva; and it is held that after exposure to cold or similar

predisposition the micro-organism gains greater virulence or the lungs become less resisting. There are, however, other micro-organisms which occasionally seem the causative agents. Among these the bacillus of Friedländer, the bacillus of influenza, the streptococcus pyogenes, and staphylococci are prominent.

The evidence in favor of contagiousness of pneumonia of both forms is fairly convincing, though the contagiousness is slight. I have seen a local epidemic in a children's hospital in which the disease crept from bed to bed around the ward, and similar instances are common in the recent literature of the disease.

Morbid Anatomy.—The stages in the morbid anatomy are exactly the same as in the adult, but more frequently there is a coexistence of the several stages in the child, so that when one part of the lung is newly congested another may show the most advanced consolidation or beginning resolution. The stages are those of congestion, consolidation, red and gray, and resolution. During the first stage the lung is swollen and red, and the surface of a section is smooth and moist. The fluid which flows from the cut surface contains air and is bloody. In the stage of consolidation the lung becomes solid or hepatized; it is friable, so that the finger easily tears through it, and the surface is granular and dry. The granular appearance is due to the fibrinous exudate which fills up the air-vesicles and smaller bronchioles. Microscopically, the vesicles are seen to contain a fibrin network enclosing leucocytes, red corpuscles, and a few desquamated cells of the lining membrane of the vesicle; and the blood-vessels of the intervesicular septa are over-full. In the first stage of consolidation, that of red hepatization, the number of red corpuscles is very great, but in the stage of gray hepatization they have largely been removed. During resolution the exudate rapidly undergoes softening and is expectorated or absorbed.

More rarely, termination in abscess-formation or gangrene results, or chronic pneumonia may follow as a sequel.

As in adults, croupous pneumonia of children is a lobar process, but it is far more frequently a bilateral disease in children. The lobe most frequently affected is the lower lobe of the right lung, as in adults. Apex pneumonia, however, is as common a disease in children as it is uncommon in adults, and some writers claim the right apex as the more frequent seat.

In every case in which the pneumonic consolidation reaches the pleural surface of the lung there is a certain amount of plastic pleurisy. More rarely effusion of liquid occurs, and I have seen extensive empyema result. In some cases there is also a concomitant bronchitis. This condition is occasionally found in croupous pneumonia of adults, but with not nearly so great frequency as in children.

Symptoms.—The onset of croupous pneumonia in children, as in adults, is usually abrupt, but there may be a short prodromal period during which the child is drowsy or restless and chilly, or coughs slightly and complains of pain in the side. As a rule, however, the onset is decided, a paroxysm of vomiting or convulsions, with rapid rise of temperature, at once calling attention to the seriousness of the malady. Rigor may be present, but distinct chill, such as is so constantly noted in adults, is rarely met with. Instead of this, convulsions and vomiting, especially when indiscretions in diet have preceded the onset, are very common in young children. The temperature rises rapidly, and in a few hours may reach 104° F. It continues during the course of the disease with moderate daily remissions, and declines at its termination by rapid crisis. More rarely decided remissions and gradual decline may mark

the case. With the rise of temperature great rapidity of pulse is noted, but even greater relative rapidity of the respirations, and in bad cases dyspnœa is a most urgent symptom. The child lies on the affected side, and from time to time is seized with paroxysms of sharp, short cough. In young children the grimaces and cry give evidence of the pain experienced during coughing, and older children complain of pain in the side or abdomen. Expectoration is rarely seen excepting in children over seven years, when it may occur, and presents the characteristic hæmorrhagic or rusty character so commonly seen

FIG. 1.

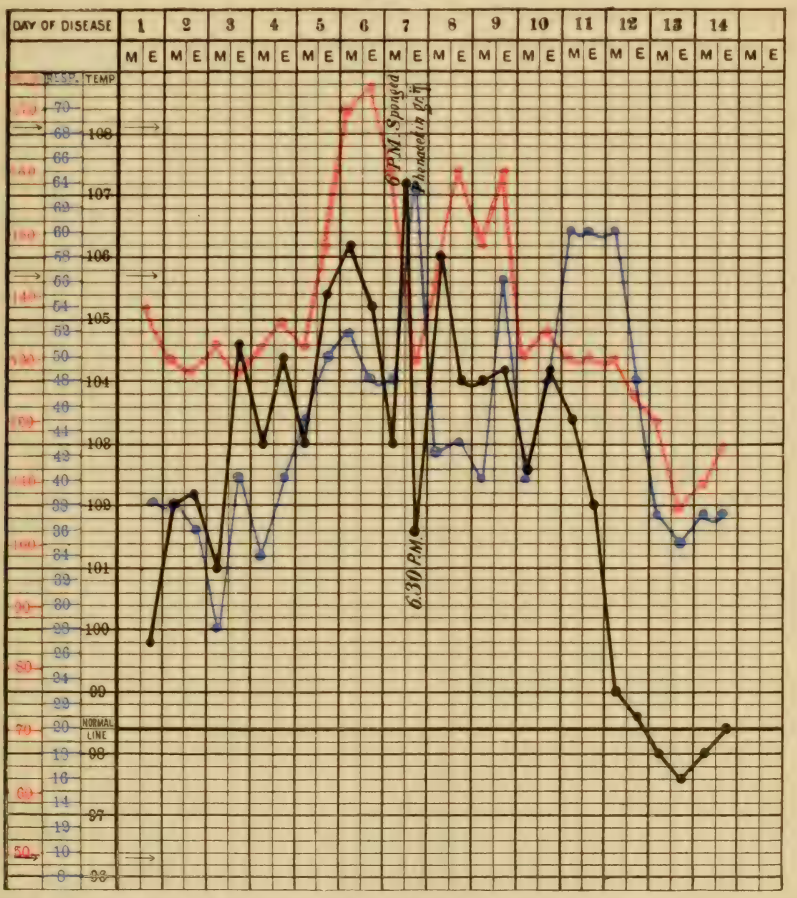


Chart of Temperature (rectal), Pulse, and Respiration in Croupous Pneumonia of the apex of the left lung in a patient three years old; recovery.

in the pneumonia of adults. The child may be restless and irritable, and insist upon being constantly changed from the nurse's arms to the bed; but when the disease is most severe and dyspnœa is marked, complete apathy is apt to be developed. The face is flushed, and particularly a bright red spot may be seen on the cheek or region of the zygoma of one or both sides; the alæ of the nose dilate with each inspiratory effort; herpes is often seen upon the lips. The tongue is coated, the appetite is lost, and in certain cases vomiting and diarrhœa may persist throughout the disease. Ordinarily in mild cases, when convulsions or delirium have been present at the onset, they rapidly dis-

appear with full development of the disease, but in severe cases nervous symptoms may take a prominent place throughout the case, and in some malignant forms death may occur in convulsion before the appearance of the ordinary symptoms of the disease.

In bad cases as the disease nears a fatal termination the respiratory efforts become more and more rapid and irregular; the pulse becomes more rapid and weak; duskiness or cyanosis may develop, with increasing drowsiness and stupor, and the child may die convulsed or comatose. In favorable cases the temperature rapidly declines about the seventh to the tenth day, and during the early days of convalescence remains subnormal. Coincidently with the decline of temperature the dyspnœa becomes less urgent, the pulse gains in force, the nervous symptoms, if marked, soon disappear, and convalescence proceeds. Sometimes, however, convalescence is rendered tedious by diarrhœa or stomatitis or by tendency to slight recrudescences of the fever.

Varieties.—Though, as a rule, the symptoms in croupous pneumonia have a typical and regular course, there are occasional cases in which the manifestations are so irregular as to warrant the description of certain clinical varieties: (1) Cerebral pneumonia is a type in which from the onset excessive pyrexia and nervous symptoms, such as delirium, convulsions, or coma, so dominate the case that the underlying disease might readily be overlooked, and the existence of meningitis be suspected, especially as cough and other pulmonary indications may be wholly absent. Such cases are most frequently observed in children debilitated by previous disease, and very often the pneumonic changes affect the apex of the lung. The relation of apical involvement to severity of nervous symptoms has, however, been greatly exaggerated. (2) Abdominal pneumonia is a less common variety, in which vomiting and diarrhœa, with marked abdominal pain, are prominent symptoms. In some cases these may be so decided as to indicate the existence of gastro-enteritis, or, when pain and abdominal distension are excessive, of acute peritonitis. In a small number of cases, especially of basal pneumonia of the right side, jaundice is noted, and to such the term "bilious pneumonia" has been applied. (3) Wandering pneumonia, or *pneumonia migrans*, bears so close a similarity to broncho-pneumonia that the distinction requires the greatest care. The disease affects one portion of the lung after another, and gives to the case an irregular and lingering nature quite unusual in the croupous form of pneumonia. By the completion of the disease consolidation may have been present in every part of the lung, but the consolidation is usually not well marked.

Physical Signs.—The physical signs are often less distinctive than in adults, and it is especially to be remembered that the apex is almost as frequently the seat of the disease as the base, and that bilateral pneumonia is a much commoner condition in young children than in adults. In a typical case, however, the signs are quite decided. The respiratory expansion is often seen to be lessened on the affected side; percussion and auscultation give evidence of the consolidation of the lung. Dulness on percussion is never so decided as in older persons, and sometimes the emphysematous condition of the lung surrounding a centrally located pneumonia may cause the percussion note to be hyper-resonant or tympanitic. In these cases deep percussion may reveal the true condition of things, or the consolidation may subsequently extend to the surface of the lung. On auscultation the typical crepitant râle of pneumonia may he heard in a minority of the cases, either with ordinary breathing or during the deep inspiratory efforts after coughing. In 31 cases of the late Dr. Meigs and myself, the crepitant râle was heard in but 10.

Subsequently, when consolidation is complete, the breath-sounds become decidedly bronchial, as we found in 46 of 57 cases; and the vocal resonance and fremitus may be found increased over the affected areas. The latter, however, are untrustworthy signs and difficult to determine. In children under five or six it is not unusual to find evidences of bronchitis in addition to the signs of consolidation, and coarse moist râles may persist throughout the case. In any case moist râles become prominent during resolution and give evidence of the softening of the exudate.

The physical signs are subject to wide variations in certain atypical cases. Thus the existence of a large pleuritic exudate of plastic nature would render the dulness decided, without altering the breath-sounds otherwise than by muffling them to a greater or less extent. In the rare cases in which liquid effusion occurs this condition becomes still more marked, and the auscultatory signs may be completely obscured. Wandering pneumonia is apt to be peculiar, not only in its migratory character, but also in the incompleteness of the consolidation, so that but a small area of dulness may be detected.

Complications and Sequels.—Pleurisy is a constant accompaniment of pneumonia which reaches the surface of the lung, but is usually of no great severity. Effusion may, however, supervene, and in the pneumonias of measles, scarlet fever, and typhoid fever, purulent effusion is occasionally met with. Pericarditis may also occur, either alone or following the pleuritic complication. The excessive nervous symptoms of cerebral pneumonia frequently create the suspicion of meningitis, but this does not actually occur so frequently as the symptoms would indicate. In such cases also hyperpyrexia becomes so decided as to amount to a complication. The occurrence of jaundice has been alluded to in the reference to abdominal pneumonia. Nephritis is a complication met with in a certain proportion of cases, and one which materially increases the gravity of the disease. It is much commoner in the pneumonia of children than in that of adults. Abscess and gangrene of the lung are rare sequels, as is also chronic indurative pneumonia.

Diagnosis.—The sudden onset of pneumonia with vomiting and convulsion and high fever simulates very closely the onset of scarlatina. The distinction is, however, rarely difficult if the excessive rapidity of the pulse, the soreness of the throat, and the early appearance of a rash in scarlet fever be kept in mind, and the physical examination for the signs of pneumonia be carefully applied.

When the disease is fully developed it may be extremely difficult to distinguish it from broncho-pneumonia, especially from cases of the latter which become lobar by confluence. On the other hand, a wandering type of croupous pneumonia with imperfectly developed consolidation may simulate an ordinary form of broncho-pneumonia, but the diagnosis is sufficiently detailed in the description of that disease. Acute meningitis is often suspected when profound nervous symptoms make their appearance, and indeed the latter may obscure the underlying pneumonia. In such cases only a careful physical examination will reveal the existence of pneumonia; and, as for a complicating meningitis, it must be remembered that such is far less common than we might suppose from the symptoms. The abdominal type of pneumonia is sometimes mistaken for gastro-enteritis, peritonitis, or even acute ileus, and is only recognized by careful study of the breathing of the patient and by the physical signs.

Pleurisy with effusion is distinguished by the decidedly dull or flat percussion note and the movable character of this dulness; by the absence of breath-sounds, râles, and vocal fremitus; and by the milder character of the symp-

toms. At its onset pain is more severe than in pneumonia, but fever and the general depression of the child are decidedly less marked.

Prognosis.—Primary croupous pneumonia of young children is a disease of little gravity compared with the same disease in adults or with bronchopneumonia of children. Of 60 cases, nearly one-half of them under two years, Baginski lost but 4. In secondary cases, however, the prognosis is much more grave, and in those dependent upon primary septic diseases the mortality is very high. As a rule, marked dyspnœa, high fever, and pronounced nervous symptoms are indications of evil omen; but common experience has shown that in this disease, of all others, a favorable termination may follow the most desperate case. Complications, such as pleurisy or pericarditis and extensive involvement of one or both lungs, naturally make prognosis more unfavorable.

It is to be remembered also that croupous pneumonia tends to relapse, and that second attacks at remote periods are not unusual.

Treatment.—The seriousness of the disease requires that the patient be at once placed at rest in bed. The room should be kept at an even temperature of about 68° to 70°, and drafts must be carefully avoided. It is always well to protect the chest by a jacket made of cotton batting lightly quilted. The food must be light, but nutritious; broths, junket, and milk, as a rule, prove most acceptable. Sufficient water should be permitted to relieve thirst. The medicinal treatment need not generally be a vigorous one, care being taken, however, that the strength of the patient be properly maintained. In the early stages small doses of tincture of aconite in combination with the solution of ammonium acetate or with sweet spirits of nitre serve to control the temperature and to quiet excessive action of the heart. If, however, fever becomes more decided, aconite will prove inadequate, and recourse to stronger antipyretics may be necessary; but hydrotherapic measures are more efficient. Sponging with cool water and the cold pack or bath are the safest and surest means of controlling temperature, and when carefully used give rise to no unpleasant consequences. The prejudices on the part of parents may, however, prevent their use, in which case small doses of antipyrin or phenacetin become necessary. When cough and pain in the side are troublesome symptoms, opium may be given in quantity sufficient to allay the irritation, guarding carefully, however, against excessive opiate effect. In severe cases, where general depression and cardiac weakness are marked, recourse must be had to stimulating remedies. Brandy or whiskey may be used in liberal quantity, and carbonate of ammonium is useful in cases in which the cough is tight and irritating. For the support of the heart digitalis is unquestionably the most reliable remedy, though care must be taken lest it prove disturbing to the stomach. In cases of extensive or double pneumonia, in which the strength of the child is profoundly affected and the heart and respiration losing force, stimulation must be pushed to the utmost. In such cases the hypodermatic administration of strychnine and of such diffusible stimulants as ether and aromatic spirits of ammonium may help to carry the child over the crisis, and the inhalation of compressed air or oxygen may prove of signal service. Throughout the disease the general systemic tone is well maintained by the use of quinine in suppositories, to which asafœtida may be added in case nervous symptoms become pronounced. If asafœtida does not suffice, chloral by enema may be tried, and usually exercises the happiest control.

Of late the use of serum from the blood of convalescent patients has been advocated, and has seemed to effect a crisis in some cases, but the time is not yet ripe for a definite expression on the value of such treatment.

GANGRENE AND ABSCESS OF THE LUNG.

By HENRY JACKSON, M. D.,

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I. Gangrene of the Lung.

Gangrene of the Lung is a necrosis of the pulmonary tissue, with decomposition of the affected portion, due to the invasion of the tissue by the bacteria of putrefaction.

It is important to remember that gangrene may be closely simulated by a post-mortem putrefactive softening of the lung, due to the action of the contents of the stomach. These spots may be multiple, are dark-greenish or black in color, and have a sour smell. This process is identical with the post-mortem softening so often found in the stomach and œsophagus. There is rarely found a necrosis of the lung-tissue without putrefaction; this form usually occurs in small patches. The tissue is reddish-brown in color and easily torn, but there is no odor, as in true gangrene of the lung. It is usually found in patients suffering from diabetes, and, so far as I know, it has not been met with in children.

Etiology.—Gangrene of the lung is not met with as a primary disease, but is always secondary to some other pathological condition. It is found in two classes of cases essentially different: First, gangrene may result from a lobar pneumonia; this occurs only in individuals whose general health has been seriously affected, and is especially common in drunkards. On account of the impairment of the circulation, either from local disease of the arteries or from extreme weakness of the heart, the inflammatory exudation is not absorbed; it becomes foul from the entrance of the bacteria of putrefaction, and gangrene ensues. This form of gangrene is rare in children. On the other hand, gangrene may be the result of wounds of the lung or may follow severe contusion of the chest; in the latter instance, as Orth says, the process probably results from the decomposition of unabsorbed blood. Another class of cases is found where the gangrene is the direct result of inoculation from putrefactive processes situated at a distance from the lung, which is infected by septic emboli through the blood-current, or from the aspiration of foul secretions from bronchiectatic cavities or gangrenous ulceration in the mouth and naso-pharynx.

Gangrene of the lung in children is usually met with in those of a weak constitution, with poor circulation, where some local cause can be found as the origin of the septic process. It is rarely met with except as an intercurrent disease. In 16 cases treated by Barthez and Rilliet the gangrene was associated as a complication with the following diseases: Measles, 3 cases; small-pox, scarlet fever, intestinal catarrh, tuberculosis, each 1 case; pulmonary and general tuberculosis, 3 cases; intestinal catarrh, with collapse, 2 cases; meningitis, typhoid fever, bronchitis, and pleuro-pneumonia, each 1 case.

A very considerable number of the cases of gangrene in children are associated with acute septic processes in the middle ear or foul ulcerations in the mouth or naso-pharynx. Several cases have been reported where gangrene of the lung has followed the inspiration of some foreign body. It is especially noteworthy that recovery appears to be the rule in such cases even after extensive destruction of the lung-tissue has occurred, as evidenced by the expectoration of large masses of foul pus and the demonstration of cavities by physical examination. Small patches of gangrene are not infrequently found in lungs which contain tuberculous cavities, the gangrene being dependent upon the aspiration of bits of putrid material from these cavities. Again, it is not an unusual accompaniment of chronic bronchitis with cavity-formation. The only case of gangrene in a young individual which has come under my observation was of this character. A young girl of eighteen presented herself at my clinic with the history of cough for several years; she was never strong. For many months the cough had been paroxysmal in character, and accompanied by the expectoration of large masses of fetid sputum. After moderate cough she raised at once several ounces of greenish fetid pus: the sputum contained many bacteria, but no bacilli of tuberculosis. Physical examination showed a pale, thin girl; chest long and narrow, shoulders rounded. No dulness on percussion; throughout both lungs numerous coarse, moist râles. The breath was fetid. This case was apparently one of chronic bronchitis with large bronchiectatic cavities, as shown by the sudden expectoration of large masses of sputum.

In the autopsy records of the Boston City Hospital I do not find a case of gangrene of the lung in a child, though the hospital receives quite a large number of children among its patients. I find thirteen cases of gangrene of the lung, and the list fairly covers the varying conditions in which gangrene may occur: Four cases of acute fibrinous pneumonia with gangrene: 1st. A drunkard aged fifty-four, with delirium tremens and pneumonia of both upper lobes; 2d. A woman aged thirty-five, acute abscess in peritoneal cavity and acute suppurative perihepatitis; 3d. A woman aged twenty-eight, much reduced by chronic empyema of eight months' duration; 4th. A man of thirty-six, habits not given, etiology obscure. Three cases of tuberculosis with gangrene: 1st. A man of thirty-eight, chronic nephritis, chronic endarteritis; 2d. A woman aged seventy, acute broncho-pneumonia, bed-sores, and fracture of the thigh; 3d. A man aged fifty, putrid bronchitis, cough for many years, emaciated, recent abscess in the throat. Two cases associated with surgical operations: 1st. A man aged forty-five, drunkard, syphilis, stricture of long standing, with urethral tears; 2d. Old man, operated upon for cancer of the tongue, inhalation pneumonia, and gangrene of the lung, with gangrenous pyo-pneumothorax. Two cases of injury to the head, with inhalation pneumonia, both old. One case of typhoid fever in a drunkard, with broncho-pneumonia. One case, a man aged twenty-seven, who had a gangrenous abscess of the lung and gangrenous pleurisy. These cases are collected from a large number of autopsies which include many cases of tuberculosis of the lungs and pneumonia. The only case in which there was not some previous local or constitutional disease explanatory of the gangrene is the last one mentioned.

Gangrene of the lung is, at any age, a rare disease, and, except in a few cases where it follows acute pneumonia, is usually met with in individuals of weak constitution in whom some septic process offers a point of origin for septic emboli which may be carried to the lung. It is interesting to study the autopsies made on cases of diphtheria at the Boston City Hospital as bearing upon the etiology of gangrene. In 26 cases in a continuous series, 19, or 73 per

cent., had some affection of the lungs: of these cases, 14, or 50 per cent., had acute catarrhal pneumonia; 5 had atelectasis. One of the cases of atelectasis had also a small abscess. None of these 19 cases presented evidence of gangrene of the lungs. As all these cases of pneumonia occurred in individuals with a serious local septic condition, it is evident that gangrene of the lung is rare, even in septic cases, unless the resistant power of the pulmonary tissue is impaired by a previously-existent general feebleness of the individual. In other words, the pulmonary circulation is so favorable that an acute inflammatory process does not tend to become gangrenous simply because the immediately exciting cause of the inflammation is a septic material.

A few cases of gangrene of the lung have been observed in which careful examination failed to elicit any reasonable explanation of the etiology. Such a case is reported by Holt. A child three years of age, who had not been sick except for an attack of bronchitis two years before, was suddenly taken ill; the disease ran its course with signs of acute pneumonia and bronchitis; death in two weeks. Autopsy showed right-sided pleurisy with gangrene of two-thirds of the right lower lobe.

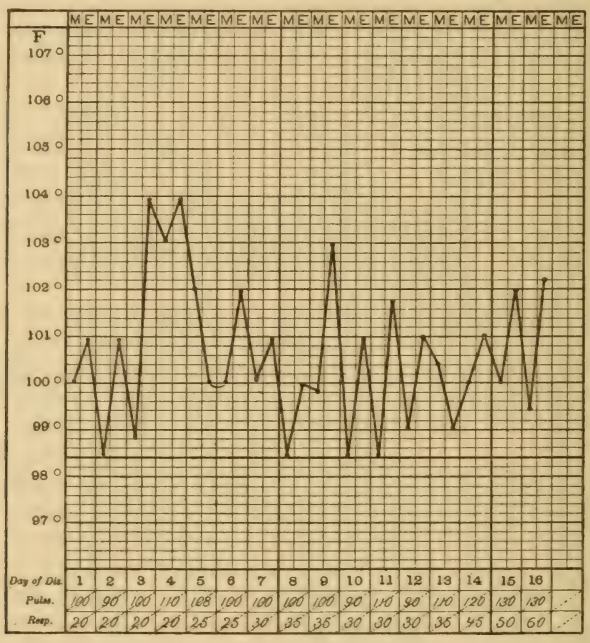
Pathology.—Gangrene of the lung may be met with as a diffused or a circumscribed process. The circumscribed form occurs more frequently in children; small patches are found scattered through the lungs; they are greenish or black in color, the tissue is softened, easily broken down, and has a most intensely fetid odor. Surrounding the patches of gangrene there is usually an area of acute inflammation, comparable to the line of demarcation which surrounds a slough. It is usual to find, in one or more of these areas of gangrene, cavities which contain a foul, dirty material composed of broken-down lung-tissue, while the walls of the cavities themselves are shreddy. When the primary lesion is in the upper part of the lung, numerous areas of gangrene are found in the lower lobes, due to the inspiration of small bits of necrotic tissue. Microscopical examination of the contents of such gangrenous areas shows the presence of bits of elastic tissue of the lung, numerous cells exhibiting fatty degeneration, and immense numbers of bacteria of many kinds; fat-crystals and globules of free fat are also met with in abundance. No specific bacteria have been found in cases of gangrene of the lung; the bacteria belong to the various species which are the etiological factors in ordinary putrefactive processes. Streng describes two cases of gangrene of the lung in which he found infusoria. The infusoria were cells about the size of a white blood-globule: they had cilia and were capable of active motion.

When the gangrenous area, in its extension, reaches the pleural surface, there results a gangrenous pleurisy, which may become encapsulated by the formation of adhesions. This formation of an encapsulated pleurisy gives at times an important hint for treatment, making it possible in suitable cases to open the lung by free incision and drain a gangrenous cavity without causing a general pleurisy. It is not unusual that during the progress of the disease small blood-vessels are eroded, thus giving rise to hæmorrhage of greater or less severity.

Symptoms.—In many cases the symptoms of the gangrene are masked by the more prominent symptoms of the primary disease, and the gangrene is only discovered at autopsy: this is especially true of children, in whom expectoration is rare. Loss of flesh and strength is rapid; the complexion is pale, gray; sweating is a prominent sign. The temperature is irregular, much more intermittent than in pneumonia: the course of the temperature may be an important guide in the differential diagnosis between an acute pneumonia and a

diffused gangrenous affection of a large part of the lung, where the physical signs point to consolidation of a large area of lung-tissue. The pulse is rapid and feeble. Physical examination yields varying results according to the area of the diseased tissue: we may find only the evidence of a bronchitis, but if

FIG. 1.



Temperature Chart of Gangrene of the Lung following operation for cancer of tongue—adult patient.

the area of gangrene is large we find dulness due to consolidation. Where large areas have been destroyed by the gangrenous process we may find, after cough with expectoration, amphoric respiration and a high-pitched tympanitic note, indicating the presence of a cavity. The breath is exceedingly foul and has a peculiar fetid, sickening odor: it is important to bear in mind that a local gangrenous process in the mouth may give rise to an odor almost as disagreeable as that of gangrene of the lung. Caries of the nasal bones with retained secretion, ozæna, gives an odor even more similar to that of gangrene of the lung. If there be expectoration, the sputum is dark greenish-yellow and very fetid: it may be large in amount, even in quite young children, as the gangrene causes the formation of large cavities, which are usually emptied at irregular intervals. An important diagnostic sign is hæmoptysis, which is of especial value in children, since with them, in other diseases, this symptom is rare. Kohts records the case of a child of three years who, after an excision of the hip-joint, spat up four or five tablespoonfuls of blood, and soon became very weak, had exceedingly foul breath, and died in a few weeks after the onset of the unfavorable symptoms.

Prognosis.—The prognosis in gangrene due to septic emboli or inhalation pneumonia is almost necessarily fatal. It is about equally bad in gangrene following pneumonia, as it is only met with in children previously much reduced. Several cases have been reported of recovery from gangrene which

had followed the swallowing of a foreign body. Kohts describes such a case which occurred in his own practice. A girl of six years swallowed a bit of bone: eight weeks later she had excessive cough with foul expectoration and fever. Ten months later she coughed up the foreign body, and finally, after a year, was completely restored to health.

Treatment.—The first indication is to sustain the strength by giving the greatest possible amount of food; stimulants may be pushed to an extreme degree. Small doses of strychnia are at times useful in asthenic forms of pneumonia as seen in diphtheria, and may be tried in gangrene. This drug acts as a stimulant to both the circulation and respiration. Direct cardiac stimulants, like tincture of strophanthus or of digitalis, are indicated if the pulse be weak and rapid. Where there is fair reason to suppose that the gangrene is circumscribed and not of very large extent, incision of the lung is admissible: this surgical procedure is, however, limited to cases that are free from general septicæmia; that is, practically, to cases of gangrene dependent upon the swallowing of a foreign body. If there be a pyo-pneumothorax, free incision of the pleural cavity is always indicated. If the child is old enough to inhale, sprays of creasote or turpentine should be used, as these modify the odor of the breath, and may aid in hastening a curative process.

II. Abscess of the Lung.

Abscess of the lung, like gangrene, may be an occasional sequel of acute lobar pneumonia in children. In such cases physical examination shows an absence of the usual signs of resolution after the subsidence of the fever. There ensues an irregular rise and fall of the temperature, the pulse becomes rapid, and there is a progressive loss of flesh and strength. It is not unusual that a large amount of pus may be raised when the abscess breaks into a bronchus; after the expectoration of such a quantity of pus there is often found amphoric respiration. The abscess often extends to the pleural surface, and finally breaks through into the pleural cavity. As the process is more chronic, pleural adhesions are more likely to occur than in gangrene of the lung; so that when the abscess breaks we have an encapsulated pleural abscess. Rarely, a neglected empyema may break into the lung and give rise to a pulmonary abscess instead of forcing its way outward through the skin.

The prognosis, in abscess of the lung, though serious, is not so absolutely unfavorable as in gangrene.

As to the general treatment, the same course may be followed as outlined in gangrene. This condition offers a better opportunity for surgical interference than does gangrene: we do not have the general septic condition to contend with. Before making a free incision into the lung the diagnosis should be confirmed by an aspirating needle, and incision should be made at the point where the pus is withdrawn.

BRONCHITIS.

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Bronchitis is an inflammation of the bronchial mucous membrane. On account of the great number of independent causes capable of producing this condition, it should be regarded as a symptom rather than a disease.

Bronchitis may be classified from several standpoints. With reference to the parts of the bronchial tree affected, it may be classified as large tube, small tube, and capillary bronchitis. Under the first category tracheitis should be included. Capillary bronchitis, referring to the inflammatory condition of the smallest bronchioles, is probably always associated with broncho-pneumonia and does not exist as a distinct entity. The term, therefore, is an unfortunate one, and should not be used; indeed, any general classification of bronchitis with reference to the anatomical distribution of the bronchial tubes is misleading and often erroneous.

As to duration, bronchitis is classified as *acute*, *chronic*, and *recurrent*. From the standpoint of origin it is denominated *primary* or *idiopathic*, and *secondary* or *symptomatic*. It is doubtful if bronchitis ever occurs as a primary disorder, an opinion which Sutton has also expressed, although it must be admitted that it is not always possible to clinically determine the antecedent conditions. As to intensity, it is convenient to adopt the division into mild and severe cases.

Etiology.—The etiological factors which lead to the production of bronchitis are exceedingly varied, and the consideration of them is one of the most important factors in the study of this subject. Much light is thrown upon the nature of bronchitis by grouping together the various elements which go to produce the disease in its different forms. Bronchitis is a constant symptom in most of the exanthemata and in some other of the acute infectious diseases, produced no doubt by a direct action of the particular poisons present. Prominent among diseases of this type are pertussis and measles. Typhoid fever is invariably accompanied by some bronchial catarrh, and, while in the adult this symptom is frequently so slight as to be practically unnoticed, it is by no means so in children, and the younger the child the more important does the symptom become. As seen in the West, a disease which seems to be typhoid fever, and is so admitted by many practitioners, is characterized by the great predominance of the bronchial symptoms; and there can be but little doubt that some cases of so-called idiopathic bronchitis in infants, some of which have advanced even to the stage of broncho-pneumonia, are manifestations of typhoid fever. While bronchitis is one of the usual symptoms of influenza, not infrequently it is the most important and most striking; particularly is this true of infants. During the prevalence of influenza, cases of bronchitis are seen that cannot be referred positively to this infection, but which probably are manifestations of it. Rubella, rather less frequently than measles, has bronchial catarrh as a symptom. In

scarlet fever bronchial catarrh rarely occurs, but the possibility of its occurrence in this disease should not be overlooked. Pulmonary tuberculosis is a common cause of bronchitis in infants. Septicæmia, or wound infection, occasionally has bronchitis as one of its numerous symptoms. Another toxic influence of great practical importance is to be found in infection from the intestine. Several years ago Sevestre called attention to cases of broncho-pneumonia accompanied by putrid diarrhœa, from which he inferred that the cause of the pneumonia was to be found in the infection from the putrid contents of the bowel. Later, his pupil, Le Sage, determined in the lungs of such cases the presence of the bacillus coli communis. More recently, similar cases have been investigated by his pupils, Gastou and Renard, who did not find the coli bacillus uniformly, but occasionally the pneumococcus, a staphylococcus, and an encapsulated bacillus. While there is no positive research going to show that a similar condition obtains in the case of bronchitis, there is clinical evidence which confirms the idea that some cases of bronchitis are due to infection or poisoning from the intestine. That poisoning by a chemical agent alone is capable of inducing the anatomical conditions of acute bronchitis has been shown very conclusively by Hamilton, who describes the appearances found in the bronchial tubes of a healthy man dead of opium-poisoning, and proves quite conclusively that the appearances found were due to the opium-poisoning exclusively. The conditions were exactly those produced at the beginning of acute bronchitis. In Bright's disease the bronchitis which occasionally occurs is no doubt a toxic symptom, although in some instances, particularly in the acute Bright's disease of children, it is an evidence of pulmonary œdema.

In infants and young children innutrition plays a most important rôle in the production of bronchitis. It is frequently asserted that dentition is a cause of bronchitis. The coexistence of dentition and bronchitis is no doubt true; the recurrence of bronchitis in certain children with the proruption of each tooth likewise is to be admitted; but in the cases which have fallen under my own observation there has invariably been a demonstrable degree of innutrition, and to this factor, rather than to the dentition, should be ascribed the occurrence of the disease. In the presence of some nutritional deficiencies, other physiological conditions, no less trifling than dentition, may be capable of exciting a bronchitis. The particular form of innutrition present is usually shown to be rickets—that is to say, a fat-starvation, characterized by profuse sweating about the head, by delayed dentition, by restlessness at night, and later by the bony changes. No doubt exposure to cold becomes active as an etiological factor in those whose nutrition is below par, but it is more than doubtful that exposure to cold alone is capable of inducing the condition of bronchitis. Nevertheless, it must be admitted that bronchitis occurs much more frequently during the cold and damp periods of the year than during the dry and warm seasons.

Inhalations of irritating gases and the accidental introduction of foreign bodies into the bronchi are capable of producing acute bronchitis in a purely mechanical way. Obstructive heart lesions, by interfering with the pulmonary circulation, may likewise lead to œdema and some of the changes of the milder form of bronchitis. Chronic bronchitis, once established, is capable by its mere presence of being the starting-point of subsequent acute attacks; indeed, any form of lung degeneration, as has been pointed out by Sutton, is capable of inducing attacks of bronchitis.

Probably the most important cause of recurrent bronchitis is the presence of enlarged bronchial glands. And when it is remembered that any acute bronchitis, no matter how trifling, may lead to the enlargement of these glands, and that acute bronchitis, in one form or another, is probably in children the

commonest of all pathological manifestations, the importance of broncho-adenitis as a cause of recurrent bronchial catarrh, and, indeed, as an independent affection, is at once apparent. It is not at all uncommon to find children suffering through several winters with attacks of bronchitis recurring at short intervals, and in almost every instance it can be found upon investigation that enlargement of the bronchial glands is at the root of the trouble. Many cases classed as phthisis pulmonalis in younger children are instances of broncho-adenitis. It must also be noted that bronchitis may be secondary to a local extension downward of any form of laryngeal inflammation.

From the wide variety of factors concerned in the production of bronchitis it is hardly to be expected that a micro-organism should be found as a specific cause of this condition; nevertheless, E. F. Grün has noted in cases of bronchitis produced by various causes, measles, whooping-cough, etc., a bacillus which he regards as the specific cause of the catarrh.

Morbid Anatomy.—A very careful study of the anatomical changes occurring in bronchitis has been made by Hamilton,[1] whose work has been referred to freely in the preparation of the following outline. The anatomical changes in *acute bronchitis* have been found to be identical, irrespective of the cause. The bronchial mucous membrane throughout is not uniformly affected, but the inflammation is found distributed either generally, in patches of greater or less extent, or limited principally to one lung or even a part of one lung. The trouble may be limited to the tubes of large calibre or may extend into the smaller tubes. The tendency to extend into the smaller tubes is more marked in children than in adults, and particularly is this true of infants. Inasmuch as the accumulation of the catarrhal products in the smaller tubes adds a gravity of its own to the situation, it is well to emphasize this peculiar tendency of the trouble in those of tender age.

On section of the lung a muco-purulent discharge is seen to ooze from the bronchi, and by squeezing the lung the same material is forced out of the smaller tubes. To the eye the surface of the mucous membrane appears congested and vessels are seen ramifying on the surface. According to Hamilton, the first microscopic change consists in the "relaxation and distention of the abundant plexus of blood-vessels ramifying in the inner fibrous coat immediately beneath the basement membrane—that is to say, of the branches of the bronchial artery." Immediately following this the basement membrane becomes thickened and œdematous and is thrown into folds. By the end of twenty or thirty hours the columnar epithelium becomes loosened and desquamates in patches. The cast-off epithelium becomes one of the elements of the catarrhal secretion, but as these cells are not reproduced until after the process ceases, they are only found in the expectoration during the early stages. During this period the bronchial secretion is diminished and the accompanying cough is spoken of as "tight." The cells of the deeper layers of the epithelium nearly all remain attached to the basement membrane, and when freed from the overlying columnar epithelium proliferate actively, and give off into the bronchial secretion an abundant mass of small round cells. The secretion is further made up of the material poured out by the mucous glands. These elements partake of the general activity. Their secreting cells become greatly distended with mucus, and, breaking down, pour out an abundance of this material into the bronchial tubes.

Throughout the whole process, according to Hamilton, the basement membrane remains intact, except in so far as it becomes thickened, and forms a barrier between the inner epithelial elements and the outer fibrous, muscular,

[1] *The Pathology of Bronchitis, etc.* London, 1883.

and lymphatic elements. Beneath the basement membrane the inner fibrous coat of the bronchus becomes thoroughly infiltrated with small cells, and, as these cells cannot pass inwardly because of the basement membrane, they make their way outwardly and infiltrate the muscularis and the outer fibrous coat. Beyond this infiltration the muscularis and the outer fibrous coat are not involved if the process ceases in the acute stage. The cellular infiltration continues outwardly, involving the interlobular septa and even reaching the pleura. Hamilton notes that the lymphatic glands at the root of the lung, the bronchial glands, are invariably involved in the process and become enlarged. This harmonizes with clinical experience. Particularly in infants and young children does this change take place. There is no one item in the morbid anatomy of bronchitis which is of greater consequence than this. It is important to note that enlargement of the bronchial glands occurs in every case of bronchitis; that in sharp attacks or after repeated attacks the enlargement becomes considerable; and that the enlargement is not always tuberculous, but may become so. A considerable enlargement of the bronchial glands is not infrequently mistaken for pulmonary phthisis. As has already been noted, broncho-adenitis is a potent factor in the further production of bronchitis, and should always be suspected in the presence of recurrent or chronic bronchitis. It is furthermore important in that it leads to the establishment of anæmia and to delayed convalescence, for, as Rachford has shown, disease of the lymphatic system is a potent factor in the production of chronic anæmia in children, with resulting malnutrition.

When an acute bronchitis has run its course and is about to terminate in resolution, the vascular congestion and the epithelial activity ceases, the mucopurulent secretion grows less, and finally the columnar epithelium is redeveloped over the denuded spots from the now less active epithelium beneath.

During the course of bronchitis it sometimes happens that atelectasis or collapse of lobules occurs. The amount and distribution of collapse varies very greatly. It is usually associated with emphysema and with broncho-pneumonia, which supervene under the same conditions as favor the occurrence of atelectasis. Broncho-pneumonia is the most serious termination of bronchitis.

Chronic bronchitis may result from the acute form or follow obstructive heart lesions, or it may be produced by the inhalation of foreign matter. When the acute form fails to undergo resolution, the small cell infiltration of the fibrous coats continues, and results in an enormous thickening of the whole bronchus. This thickening causes a diminution in the calibre of the tube, and further leads to atrophy and absorption of the muscularis and cartilages. The diminished elasticity of the bronchia then favors the formation of fusiform dilatations. If the infiltration goes on, the formation of fibrous tissue, so-called interstitial pneumonia, ensues. The subsequent contraction of this tissue, particularly that which has been formed in the interlobular septa, draws out the bronchial walls in places, leaving irregular dilatations of the tubes. This condition, known as *bronchiectasis*, is a potent factor in the causation of subsequent acute attacks. Among the lesions of chronic bronchitis atelectasis and emphysema are always found.

Symptoms.—Acute bronchitis varies in its severity from an exceedingly mild to an exceedingly severe type. The character of its onset is largely determined by the causes which lead to it. In the milder forms the onset may be rather insidious, but sometimes it commences sharply with feelings of malaise, some elevation of temperature, cough, soreness of the chest, and at times with catarrh of other mucous surfaces, as those of the larynx, the throat, and the nose. In this form none of the symptoms become severe, although the cough

may be somewhat distressing. The fever does not reach a point to attract attention, and, if the child be young, expectoration does not occur. Such an attack usually lasts three or four days, but may be prolonged, according to the cause which has produced it, for several weeks.

In the earliest stages of bronchitis the cough is dry and rasping, and individual paroxysms are apt to be prolonged. The secretion at first is scanty, but after twenty-four to thirty-six hours becomes freer. It is removed from the bronchial tubes by the act of coughing, but in the case of infants and young children it is not expectorated; indeed, it is with great difficulty that infants can remove the secretion from the bronchial tubes into the mouth, and when once in the mouth it is swallowed and not expectorated. Expectoration is an art which has to be acquired, and usually is not learned until the sixth or seventh year of life. A cough which is sufficiently severe to cause expulsion of bronchial secretion from the mouth in children who have not yet acquired the art of expectorating is usually whooping-cough. The swallowed secretion occasionally produces some disturbance of the large bowel, and may be associated with mucous diarrhœa, but the mucus in the movements, while in part originally secreted in the bronchial tubes, is also in part formed in the intestine itself. It is to be noted in this connection that a mucous diarrhœa may be induced on the one hand by a bronchitis, and on the other hand a bronchitis may be produced as the result of a diarrhœa, or at least as the result of a putrid condition of the intestinal contents. In milder cases of bronchitis the respiration is not particularly hurried; in young infants, however, it becomes quite rapid even in mild cases. In the severer forms of bronchitis, where there is much thickening of the bronchial mucous membrane and great difficulty in the removal of the bronchial secretion, and a corresponding interference with aëration, the respirations become correspondingly rapid. But the difficult respiration of acute bronchitis cannot always be attributed to mechanical occlusion of the bronchial tubes, for not infrequently great dyspnœa will be present and disappear suddenly without a corresponding removal of mucus from the bronchi. Difficulty of respiration is manifested in several ways: First, by an increase in the rate of respiration; second, by dyspnœa; third, by special forms of dyspnœa, particularly the grunting expiration. When dyspnœa is present the alæ of the nose dilate on inspiration, and if the dyspnœa be due to mechanical causes, the tissues above the sternum and the soft parts along the insertion of the diaphragm sink in during inspiration. These symptoms, which usually are diagnostic of broncho-pneumonia, may be occasionally found in cases in which the evidences of pneumonia are not altogether clear and in which only bronchitis can be made out. But, inasmuch as they not infrequently disappear quite suddenly in a manner that seems impossible in broncho-pneumonia, it is justifiable to assume that they are indeed the result of a bronchitis pure and simple. Even in broncho-pneumonia the dyspnœa is at times entirely out of proportion to the amount of lung-tissue invaded, and cannot be explained entirely by the mechanical obstruction to the aëration of the blood. It is simpler to suppose that such are cases of toxæmia, in which the dyspnœa is itself a toxic manifestation, in part at least.

In severe forms of bronchitis the respiration may become exceedingly rapid, but the pulse, while frequent, may not be increased in proportion to the respiration. The temperature varies greatly in different cases, but usually there is some elevation. It is hard to believe, however, that bronchitis, of itself, necessarily causes an elevation of temperature, and it is more than likely that the associated pyrexia is a distinct and co-ordinate symptom produced by the same factors which cause the bronchial catarrh. No definite temperature curve can

be ascribed to bronchitis; it follows the other conditions present, and in the severer forms runs high.

The facies of severe bronchitis resembles that of broncho-pneumonia; that is to say, the countenance is anxious, the alæ of the nose dilate, the lips may become cyanotic, and in general the countenance indicates distress. Under such conditions it is perhaps true that broncho-pneumonia is usually present to a greater or less degree, but this is certainly not always the case, as this facies is sometimes found in bronchitis which has invaded only the larger tubes. Nevertheless, the prognosis, whether broncho-pneumonia be found upon physical examination or not, is grave in accordance with the facies just described.

Nervous symptoms are often very marked in the severer forms. Great restlessness occurs not only as a result of the difficulty of respiration, but also as a toxic symptom. Ataxic features are occasionally noticeable, and drowsiness deepening into coma is at times seen. A toxic or so-called febrile dyspnœa is often met with: that is to say, a dyspnœa which is out of proportion to the mechanical conditions present, and apparently due to the same or a coincident cause as that producing the fever. The grunting expiration, noted above, is often of this type; it usually occurs when the rate of respiration is not greatly increased, and, while present during the waking hours, disappears during sleep. The bronchitis which is caused by the putrefaction of bowel-contents is essentially toxic. Often mild, it may be very severe and accompanied by great acceleration of respiration, by dyspnœa, and by marked head symptoms. An uncomplicated case of this kind is relieved by the action of a suitable purgative, the most marked symptoms disappearing at once, leaving no doubt of the toxic origin.

The cough which accompanies enlargement of the bronchial glands is usually dry and harassing, and often assumes a croupy character. Not infrequently, however, the accompanying bronchitis is severe, and may continue for weeks or even months with a profuse bronchial secretion, showing little or no tendency to recovery. This is but one phase of the condition which Dr. B. K. Rachford[1] designates by the term "scrofulous bronchitis." He describes it as follows: "It is, as a rule, recurrent, coming on during the cold and disagreeable winter months and disappearing during the summer months. It is characterized by marked anæmia, and as a rule by other well-known signs of scrofula, such as enlarged external lymphatics, chronic coryza, etc. In these cases of scrofulous bronchitis there may be extensive tubercular disease of the deep-seated lymphatics of the abdomen or chest, without any evidence whatever of external scrofulosis. In such cases the well-marked anæmia and the possible family history of tuberculosis will be of material aid in diagnosis."

This form is very often mistaken for pulmonary tuberculosis, but it may extend over a very prolonged period without the production of pulmonary phthisis, although it tends to that termination. The prognosis is about the same as in other forms of glandular tuberculosis.

Bronchitis is accompanied by a great variety of symptoms referable to other organs and variable, inasmuch as the associated features are determined by the particular causes which produce the bronchitis, and necessarily must vary with them.

Chronic bronchitis in children does not differ sufficiently from the same condition in adults, either in its symptoms or treatment, to require separate consideration.

Prognosis.—Prognosis as to duration should be guarded, as it depends upon the cause which has produced the disease. Those cases which we are com-

[1] Personal communication.

pelled to recognize clinically as idiopathic bronchitis usually, when mild, terminate in three or four days, and even when severe rarely last more than a week or ten days. A bronchitis which is caused by typhoid fever will last from ten days to three weeks, and disappear with the disease which it accompanies. In the case of pertussis the bronchitis may be prolonged quite indefinitely. In measles, while it may disappear in four or five days, it not infrequently lasts several weeks. Bronchitis of purely intestinal origin, usually disappears immediately upon the removal of the bowel-contents.

Prognosis as to severity is determined by a number of factors, but ordinarily it is good. It is customary to say that the prognosis in bronchitis of the larger tubes is more favorable than in bronchitis of the smaller tubes, and in general this is true, but by no means is it always so, as some of the most severe attacks, so far as fever, depression, and other nervous symptoms go, are those in which the large tubes only are affected. The age of the patient is always an important element in the prognosis. The infant with bronchitis is to be regarded as always in danger, as broncho-pneumonia may readily supervene. The exciting causes of the attack must also be taken into consideration. Bronchitis symptomatic of a general infection, such as measles, is very likely to be commensurate with the other symptoms so far as severity is concerned. The presence of enlarged bronchial glands is to be taken as indicating a prolongation or recurrence of the trouble, and as paving the way for a possible termination in pulmonary phthisis. The condition of the child's nutrition determines to a very considerable degree the severity of an attack. Where the nutrition is below par, particularly where rickets is well marked, the disease is apt to prove very severe, and to take upon itself suddenly severe nervous symptoms or to lead to the development of broncho-pneumonia. Marasmus and great weakness from any cause, interfering with the prompt expulsion from the tubes of the accumulating secretions, are conditions unfavorable to the satisfactory progress of the case. The cough *per se* is of but little aid in prognosis. It may be very severe in children who are evidently but slightly ill, and, again, may be nearly absent in children who are in great danger. The character of the respiration is of more importance from a prognostic standpoint. Whenever it becomes rapid, or its rhythm is interfered with, or the grunting expiration appears, or dyspnœa manifests itself, the prognosis should be guarded. With improvement of the respiration in rate and rhythm a more favorable prognosis may be made. The temperature is often an important guide: the higher the temperature, other things being equal, the graver the prognosis; the lower the temperature, the better the outlook. With a pulse that tends to irregularity irrespective of the temperature and respiration-rate, the prognosis is not favorable. But more important than all these symptoms is the condition of the brain, delirium in any of its forms having its usual grave significance. Intense cardiac depression, and sleeplessness, or, on the other hand, somnolence, all are indicative of severe and threatening conditions.

Diagnosis.—The diagnosis involves the recognition of the existence of the bronchial catarrh itself, and the determination, so far as possible, of the etiological factors. The existence of bronchitis is ordinarily recognized without any difficulty. The history of cough, with bronchial secretion of recent origin, is usually enough to establish the diagnosis. An examination of the chest, which should always be made, will decide. In the earlier stages, before the secretion has become established, sibilant and sonorous râles are heard. Not infrequently, however, these râles are very scanty, and not always heard on both sides of the chest. Later the râles become moist and more numerous. When the smaller tubes are invaded, small and even subcrepitant râles are

heard. At no time in an uncomplicated bronchitis is there any modification of the percussion note.

The severer forms are to be differentiated from pneumonia. This can only be done by the detection of the consolidated pneumonic area by percussion and auscultation. The consolidated area is expected to show dulness on percussion, and bronchophony and bronchial breathing on auscultation. But when the area is small and centrally located, these signs cannot always be made out. Fortunately, it is not of the highest importance to determine these conditions exactly, because the prognosis and treatment will not be essentially modified by the presence of a small area of pneumonic consolidation.

Pleural effusion, whether serous or purulent, does not always present specific symptoms indicating its nature, but is often shown only by a cough which may readily be mistaken for that of bronchitis. The physical examination will always differentiate these conditions.

The presence of bronchitis being once established, the search for the etiological factors begins. The existence of one of the exanthemata as a causative factor is usually readily made out by the history and appearance of the child. Pertussis, however, is difficult to determine before the occurrence of the convulsive stage. It may be suspected, however, if the cough be very severe and the disease be prevalent. Influenza usually presents its neuralgic and other nervous features. The character of the stools should always be carefully inquired into, and if there be any suspicion of putridity of the bowel-contents, the fact should be noted as a possible factor in the case. The condition of the nutrition should be carefully studied, particularly in infants, and if the history shows the occurrence of profuse sweating, especially about the head at night, with great restlessness and a tendency to lie uncovered, if there be beading of the ribs, recurrent bronchial attacks during dentition, and occasional laryngismus stridulus, rickets is to be diagnosticated.

Treatment.—The treatment of bronchitis includes attention to the local conditions in the chest, to the general constitutional disturbance, and to the removal, as far as possible, of the causative factors. It is not convenient, however, to divide the description of the treatment with strict reference to these three factors, but rather to consider the matter somewhat in the order in which the various steps are undertaken in actual practice.

The very mildest cases require no treatment whatever, but they should always be watched, particularly in infants, so that interference may be made as soon as necessary.

It is good practice to commence the treatment of every case of bronchitis in infants and young children with the use of a laxative, the reason for this being that the intestinal tract of the infant so commonly contains putrid fæces which do not always manifest themselves by special signs. In older children some signs of bowel disturbance may be waited for, but in severe cases the character of the bowel-contents should always be investigated by the aid of purgatives. Besides their action on the bowels, purgatives deplete the liver and prepare that organ to receive some of the blood which has been determined to the bronchi. The most available laxatives are castor oil and calomel.

Calomel, which is preferable in the infant, should be administered in three doses, of one grain each, at intervals of four or five hours. When putrid fæces are found, all animal food should be prohibited for one or two days, and such intestinal antiseptics as naphthaline and salol administered.

Expectorants are often of great service in the earlier stages of bronchitis, but, as a rule, they are abused. Their sole use is to cause an increase in the bronchial secretion. When the secretion is scanty, and the râles few and dry,

and the cough, in consequence, frequent and harassing, expectorants afford relief. But when the secretion has become thoroughly established, and auscultation shows the râles to be abundant and moist, then expectorants are of no further use, and it is better to withhold them. The best expectorants are ammonium chloride and potassium iodide. The following formula may be employed for an infant from three to six months of age:

℞. Ammon. chlorid. . . . . gr. xvj.
Syr. tolutan. . . . . .
Aq. destillat. . . . . āā f℥j.—M.
Sig. One teaspoonful in a little water every two or three hours.

Ipecacuanha is widely used. It is of peculiar value because, besides increasing secretion, it tends to dilate the cutaneous capillaries. When the secretion is excessive and the efforts at coughing inadequate to remove the accumulation, emesis affords much relief. For this purpose ipecacuanha is valuable.

The modern coal-tar antipyretics have a marked effect in bronchitis. They appear to act almost as specifics, diminishing the amount of secretion, lessening the severity and frequency of the cough, and relieving pain, without acting like opium in simply covering up symptoms. Of these, the safest probably is phenacetin. For an infant from six months to two years of age the following formula will be found useful:

℞. Phenacetin . . . . . gr. xii–xxiv.
Caffeine . . . . . gr. j–ij.—M.
Div. in chart. No. xii.
Sig. Give one powder every four hours.

The smaller dose may be used at six months and the larger at two years. For younger infants the dose should be reduced, and for older children slightly increased. These powders are advantageously alternated with the calomel powders given at first. Here, as elsewhere, phenacetin should be used cautiously, withheld entirely from weakly children, and never continued over a long period.

In severer cases the inhalation of antiseptic vapors seems at times to be useful. For this purpose it is convenient to evaporate turpentine or oil of eucalyptus from a water-bath in the patient's room.

Particularly in the bronchitis of infants and young children is the cough salutary, and it should be laid down as a cardinal rule that no effort should be made to smother it. Narcotics and antispasmodics distinctly increase the tendency to pneumonia. But it is not always possible to dispense entirely with the use of opium. In some very severe cases, where there is great restlessness, a single full dose of opium to produce sleep is occasionally necessary. Used in this way, the best results to the patient are obtained with a minimum of danger.

Certain means very commonly employed in the treatment of bronchitis and pneumonia have for their object the relief of internal congestion by the production of a dilatation of the cutaneous capillaries. These are the poultice jacket, the cotton and oiled silk jacket, local counter-irritation, and the internal use of sweet spirits of nitre, alcohol, and aconite. Redness of the chest-wall is readily obtained by thorough friction with camphorated oil or an ointment of turpentine and lard. It is rarely necessary to use mustard. The

agent selected should be well rubbed on twice each day, and the redness maintained by the use of the poultice jacket or the jacket of cotton batting and oiled silk. When poultices are used, two should be made—a smaller one to lie upon the front of the chest, and a larger and heavier one to cover the back and sides of the chest and lap over the front poultice. As their object is to keep the skin red, they must be as warm as can be borne, and changed often enough to prevent cooling. The advantage of two poultices is to be found in the changing. The one at the back does not cool as rapidly as the front, which must be the thinner, so as to embarrass the respiration as little as possible. Hence the front poultice requires changing oftener than the back. Poultices which are allowed to become cold constitute an element of danger, and therefore should not be used on patients when the nursing is inferior. They are disadvantageous also to very weak children, to whom their weight is a burden. When properly employed their action is of the greatest service, and they should always be used in properly selected severe cases. As a substitute for the poultice the chest may be enveloped in a thick layer of cotton batting, and this covered with oiled silk. This dressing, while inferior to poultices, is yet so convenient and so serviceable that it should always be employed, in conjunction with camphorated oil, even in quite mild cases.

The principal utility of alcohol in bronchitis has seemed to the writer to be due to its power of relaxing the cutaneous capillaries. For this purpose it is best administered in rather small doses at frequent intervals, and in the shape of whiskey or some light, non-astringent wine. Sweet spirits of nitre, so commonly employed in febrile conditions, is often of great service in bronchitis, particularly when there is fever. It dilates the cutaneous capillaries, acts as a diaphoretic, and by its diuretic action no doubt assists in the elimination of toxic principles.

When bronchitis is produced by any of the specific fevers the cause cannot be directly removed, but treatment directed to the amelioration of the complexus of febrile conditions relieves the bronchitis, as it does the other manifestations of the poison. In those specific fevers which are best treated by the application of cold the presence of bronchitis is not to be regarded as a contraindication of the means.

Convalescence from bronchitis is always worthy of attention, and after severe cases, where the bronchial glands are considerably enlarged, treatment of this stage is highly important. Fortunately, proper medical attention at this period produces excellent results and prevents much subsequent trouble.

In the treatment of broncho-adenitis cod-liver oil is a most important agent. It is usually desirable to administer it plain, and by most infants it is well borne. Its use should be continued for three or four weeks, and even longer if the trouble does not yield readily.

When the bronchial glands are enlarged a coexisting anæmia will usually require the use of iron. This agent is best administered as the reduced iron or the freshly-prepared saccharated carbonate of iron. In either case the dose should be large. Reduced iron in 5-grain doses three times a day to a child two years old will give better results than smaller doses. For very young infants iron is best administered in the shape of freshly-expressed beef-juice, which may be given in teaspoonful doses three times a day.

The iodides may at times be used advantageously, and of these the best are the syrup of hydriodic acid and potassium iodide. The latter should be given in small doses, $\frac{1}{2}$ grain to 1 grain, three times a day, and well diluted. The syrup of the iodide of iron is rather disappointing in its action.

It is often desirable to use creasote or guaiacol, particularly where the

glandular enlargement is very pronounced and general tuberculous infection is feared. The following is a convenient formula for a creasote emulsion :

℞. Creasoti (beechwood) . . . . . fʒj.
Pulv. acaciæ . . . . . gr. xv.
Aq. dest. . . . . ♏xlv.
Glycerini . . . . . q. s. ad fʒss.—M.

Sig. Four to eight drops in port wine three times a day.

Ordinarily it is not desirable to commence treatment of the broncho-adenitis along these lines until after the subsidence of the acute attack of bronchitis. Cases presenting nutritional deficiencies call for treatment both during and after the attack. In most instances the innutrition in infants is due to rickets, and cod-liver oil and iron act almost as specifics. Salt baths and out-door exercise are also valuable, and should never be omitted.

In older children, the subjects of scrofulous bronchitis, the underlying nutritional deficiencies particularly call for treatment. In these cases cod-liver oil, iron, and iodine, while of service, are often disappointing, and do not yield the satisfactory results obtained by their use in less severe cases, where enlargement of the bronchial glands constitutes the principal departure from the normal. In the severer cases of this type relief can only be obtained by removal to a warm climate or to the sea-shore. In the experience of the writer the Florida coast has afforded great relief to such patients.

PLEURISY AND EMPYEMA.

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Pleurisy, or pleuritis, occurs in infancy and childhood usually as a secondary, and rarely as a primary, disease. There are certain forms in which the pleura is inflamed without any appreciable exudate; such are called *dry* or *fibrinous* pleurisies. Other forms combine the above with an exudate of fluid—serous, sero-purulent, or purulent—into the pleural cavity. These forms are called *pleurisy with effusion*, or sometimes, less accurately, *subacute pleurisy*. When the exudate has a sero-purulent character or is visibly purulent, the pleurisies have been called empyema. *Empyema* in this article will, for the sake of uniformity, be called *purulent* or *suppurative pleurisy*, while those pleurisies which have a protracted course and are due to neoplasms will be referred to only.

Frequency.—Pleurisy is a common disease of infancy and childhood. The greatest number of cases occur before the fifth year of life (Simmonds). The succeeding five years (five to ten years) show the next greatest frequency. Our statistics upon pleurisy in childhood are incomplete, for the reason that authors have not unreservedly exposed their material for criticism. Only favorite methods have been published, to the exclusion of unfavorable results. This has caused much confusion. Israel has tabulated 206 cases, of which 59 were purulent (29 per cent.). Mackey gives purulent cases in children 40 per cent. as against 5 per cent. of the whole number in adults. In 240 cases 140 were boys (Simmonds). On the other hand, Hofmokl, who has a great pediatric surgical practice in Vienna, tabulates 60 cases, of which 42 were females. Thus, combining both statistics, the boys would still show the greater frequency.

The left side is more frequently the seat of disease. Of 175 cases collected by Simmonds, 103 were on the left side, whereas of the 60 tabulated by Hofmokl, 33 were on the left side.

Pleurisy is generally a unilateral disease. Of 175 cases, only 7 were bilateral (Simmonds). This is fortunate in infancy and childhood, where exudates reach a large amount in a very short time. With these youthful patients the natural resiliency of the chest combines with others factors to make even enormous exudates comparatively well borne, as contrasted with a similar condition in later life. In the adult the resistant chest-wall tends to cause greater pressure-effects and displacements of important viscera.

Pathology.—The pleura is a connective-tissue structure, made up of elastic fibres in a fibrillar membrane, containing branched connective-tissue cells and covered with a layer of flat epithelium, called, in this membrane, endothelium. In inflammations of the pleura which are not dependent upon and accompanied by a neoplastic growth (tubercle or carcinoma), the changes take place at the surface. The most frequent pleurisies are those acute processes which invari-

ably accompany the several forms of acute pulmonitis. They occasion but few symptoms *per se*, and only in the event of a fatal termination of the primary pulmonary disease do they come to the autopsy table. In these forms of pleurisy the changes may be so trifling as to be indicated only by a slight injection of the surface of the pulmonary pleura and a loss of its characteristic lustre. Here and there a few fibrinous threads or adhesions may be found coursing over the surface of the membrane or running from the costal to the pulmonary pleura. This is the so-called dry pleurisy, *pleuritis sicca*. In other cases there is a more extensive formation of fibrin, which becomes diffused over the whole surface of both the pulmonary and costal pleura; and this formation may become so marked as to cause a distinct thickening of both these surfaces. In some forms in children the amount of fluid is small compared with the immense thickening of the pleuræ. Some writers have maintained that in these fibrinous exudates the primitive endothelium may be found upon the original pleural surface, beneath the exudative product; others, that the fibrinous exudation is coated with the original endothelium (Delafield). The pleura itself may be but little altered, the only change being that its lymph-spaces and blood-vessels are dilated, and there may be a diapedesis of leucocytes.

In other forms of pleurisy the fibrinous exudation at the surface is also combined with a serous exudate into the cavity of the pleura. This serum is variable in amount: it usually contains leucocytes, in many cases bacteria, as will be shown later. It may be quite clear, turbid, or opaque, yellow or greenish in color and creamy or thin in consistency. In acute processes in children large masses of fibrin may be found floating free in the cavity of the pleura (metapneumonic cases). In many instances the adhesions are so great as to bind down the lung at various places, thus enclosing the exudate in quasi-capsular formations. Even in acute cases the fibrinous coating on the surface of the pulmonary and costal pleura contains newly-formed blood-vessels. Hæmorrhages into the pleural cavity may rarely occur as a part of such conditions as scurvy and true morbus Werlhofii, and then the serous or purulent exudate becomes a so-called hæmorrhagic one.

In some cases the fibrinous coating on the pulmonary pleura may be so thick as to seriously impair the function of the lung. In children, however, this is not common, except as a sequence of tubercular processes; so that a marked pleurisy, suppurative or fibro-serous, may be followed by a complete *restitutio ad integrum*. It is rare that in acute processes the lung is in any way compromised. It is only in prolonged, unrelieved pleurisy that this occurs, and thus there may be perforation of the exudate with erosion of the pulmonary or costal pleura (*pleuritis necessitatis*). Small purulent exudates, unrecognized during the illness, may thus perforate after all fever has ceased and the patient is apparently well.

In tubercular inflammation of the pleura, besides the production of fibrin, serum, clear or hæmorrhagic, and pus, there may be considerable thickening of the costal and pulmonary pleura, caused by the inflammatory exudate, which, as well as the pleura, is infiltrated with tubercle. In these cases the serous or purulent effusion may be encapsuled by adhesions, while the lung is crippled and bound down by layers of inflammatory tissue. In these forms of pleurisy the anatomical changes are progressive. In acute fibrinous pleurisy the exudative products on the surface of the pleura are organized into new connective tissue or partly disappear, but the pleura is restored to its original condition. Again, absorption takes place in those cases where the exudate does not demand artificial relief. In children the adhesions form an important part

of the process in acute pleuritis, while in other forms the pleura may remain permanently thickened by the formation of a surface layer of new connective tissue, which may persist through life. There are non-tubercular forms of pleurisy where, after the acute process has run its course, the pleura remains thickened by newly-formed connective tissue; and this not only involves the pleural tissue proper, but also continues to extend and involve, through the lymph-vessels, the interlobular tissue of the lung itself, causing a species of cirrhotic changes. In these cases, which are prolonged, the lung-tissue is seriously compromised.

In the exudates of the pleura there is a constant interchange of fluids through the vessels of this membrane (Gerhardt). Drugs may find their way from the general circulation into the pleuritic fluid. Iodine and salicylic acid have thus been found. Moreover, the amount of leucocytes, red blood-cells, and endothelial cells in the exudate is constantly varying, so that a serous effusion may result from a hæmorrhagic one, and an opaque purulent from a serous.

The amount of fluid effused in children is usually considerable, and may reach 1000 or 2000 c.cm. (Simmonds). Hofmokl in several cases evacuated as much as 2000 to 5000 c.cm.

The chemical composition of pleural exudates may be of clinical interest. The specific gravity varies from 1028 to 1032 (Bartels, quoted by Gerhardt). Some authors have attempted to formulate prognostic signs from the specific gravity of the pleural exudate, but few would accept such a line of thought to-day.

The amount of albumin varies from 0.06–2.68 per cent. in non-inflammatory to 2.40–6.90 per cent. in inflammatory exudates; extractives and salts in non-inflammatory exudates, 1.08 per cent., in inflammatory, 1.18 per cent.; the chlorides average 0.67 per cent. in both. Among the foreign substances, urea, uric acid, leucin, tyrosin, glucose, glycogen, cholesterin, xanthin, and medicinal agents have, at various times, been found, proving that the fluid in the pleural cavity is in direct touch with the general circulation and lymphatic system.

Etiology.—Primary pleurisy, occurring without any exciting cause in the chest or elsewhere, is rare in children. There are numbers of cases in which an acute effusion of inflammatory character takes place without any previous symptoms of illness or external exciting causes. Our data upon this very interesting and important question are still incomplete. Such a case came under the notice of the author in a boy aged six years, in whom a pleural effusion was present for a week without any previous symptoms. The liquid was serous in character, and did not contain any micro-organisms. There was no tubercular lung disease and no history of other illness. In these clinical cases the etiology is very obscure. The author has elsewhere published cases of infants where illness began acutely, nothing having been found except a tonsillitis follicularis. The chest showed no pneumonia or pleurisy at first. Within a week, however, a purulent effusion was found in the chest. In these cases it is impossible, inasmuch as recovery takes place, to establish the primary cause. In those cases which come to the autopsy table after the disease has existed a long time the pulmonary changes are no more conclusive.

Primary pleuritis, if it does occur in children, must be rare. There are so many avenues of infection that to satisfactorily exclude all these has as yet not been possible. Pleuritis in infancy and childhood is therefore mostly secondary to diseases of the lungs. All acute forms of pneumonitis—lobar pneumonia and broncho-pneumonia—may give rise to pleuritis. The greatest num-

ber of cases has been traced to this cause. Of 84 cases of pleuritis tabulated by Simmonds as occurring in children, 31 were caused primarily by pneumonia (meta-pneumonic pleurisy).

The infectious diseases, measles, scarlet fever, pertussis, typhus, typhoid, diphtheria, forms of tonsillitis, retro-pharyngeal or mediastinal abscess, may precede and directly cause an attack of pleurisy. In these cases a pneumonitis generally precedes the pleurisy or is present at the same time. Such a pleurisy is to be classed under the heading of complications. It may be serous or purulent, but is generally microbic in origin, as will be shown later. In the new-born the class of cases included under the heading of septico-pyæmia are sometimes complicated by a pleuritis, usually suppurative and of a progressive, fatal type. In these instances the pleuritis is simply caused by the same microbic agent, which enters at the umbilicus or elsewhere. Such cases have been published by the author. The acute bone diseases, such as osteomyelitis, may be complicated by purulent pleurisy; so also may septic wounds in any distant portion of the body, as the foot (Koplik).

Tubercular disease of the lung or tuberculosis elsewhere; echinococcus (Simmonds) or abscess of the liver; any abscesses in the mediastinum; forms of endocarditis; and abscesses in the abdominal cavity or involving any of the viscera,—may cause pleuritis. A case of perityphlitis in the author's practice, in a girl eight years old, after running an acute course was followed by chronic peritonitis with multiple abscess-formations in the abdominal cavity, and was later complicated by pleuritis on the right side. As no autopsy was allowed, it was impossible here to trace a direct connection, but such has been done by other authors.

In many cases of pleuritis, as in other diseases, it is possible to find as the only exciting cause an exposure to cold or dampness. This has occurred so often, and with such apparent connection, that most authors look upon cold and dampness as undoubtedly exciting toward any pulmonary or pleural inflammation. At least they are not without influence. A reduction of constitutional resistance by these agents opens the avenues for the activity of well-known exciting agents (microbic).

Traumatism of all kinds, even without a lesion of the external surface, may act like cold in exciting pleurisy. Compression of the chest-wall or a blow may not directly cause it, but certainly many cases follow so closely upon such accidents that an intimate connection seems to be the inevitable deduction.

It is conceded upon all sides that there are evanescent forms of pneumonia in children lasting only a few days. It is easy to conceive that a pleuritis may have been preceded by such a pneumonia, the symptoms of the primary disease being masked by those of the main condition, the effusion in the chest.

The etiology of pleurisy has been greatly elucidated, in recent years, by the bacteriological studies of Weichselbaum, Fraenkel, Ehrlich, and Thue. These authors have busied themselves with the study of pleuritic exudates and their relationship to processes which affect the lung. They directed their attention to the adult cases. In 1891 the author made a series of bacterioscopic studies in children, which, with certain peculiar exceptions, bring the pleurisies of children much into the line of those of the adult as to causation. We know that when the lungs are the seat of bronchitis, broncho-pneumonia, or lobar pneumonia, a number of micro-organisms play an important rôle during the course of the inflammatory processes. Thue, in a series of studies, established beyond question that these micro-organisms (notably the diplococcus pneumoniæ) can be found not only in the lung-structures, but especially in the lymph-spaces of the tissue of the pleura and on the surface of the pleura itself,

even in most evanescent inflammatory reactions of that structure. This once accepted, it is easy to explain how micro-organisms, which are *per se* capable of exciting suppuration, when they once gain the surface of the pleura will cause inflammatory response of that structure. Such is, in fact, the case. If we examine the acute pleuritic exudates in children, we find they resolve themselves into groups. The most interesting group is that in which the effusion, whether serous (clear) or purulent and full of fibrin clots and flocculi (suppurative), shows the presence of the diplococcus pneumoniæ of Fraenkel or the streptococcus lanceolatus. This micro-organism is the accepted exciting factor of both lobar (Fraenkel) and lobular pneumonia (Weichselbaum). It is found in both serous and purulent exudates (meta-pneumonic pleurisies), and this in pure culture. So constant is this that we can group such pleurisies by themselves, and both clinically and bacteriologically accept the diplococcus as the connecting link between the process in the lung and the pleuritic inflammation. It is not always possible to trace clinically the pneumonia and pleurisy in sequence, for in many of these cases the pneumonia is so slight as to play but a secondary clinical rôle. In other cases the direct clinical sequence of pneumonia followed by pleurisy can be satisfactorily established.

In another group of cases the pleuritic effusion, if examined bacterioscopically, is found to contain staphylococcus pyogenes aureus, and in other cases the streptococcus pyogenes. The exact etiological rôle played by these micro-organisms is not very apparent. It is true we can justly conclude that by their presence in the pleural cavity they have been direct excitants of the pleuritic inflammatory reaction. It is not clear, however, how they gain access to the pleural cavity, and whether the pleuritis was preceded by, or was concomitant with, some form of pneumonitis. These organisms are found in the lungs during a lobar or broncho-pneumonia. In certain forms of broncho-pneumonia following or complicating the infectious diseases, the streptococcus pyogenes is found as a chief exciting factor of the pneumonitis. This has been well established by Babes, Prudden, and Northrup. But there is a class of pleurisies in children which are not secondary to the acute infectious diseases, and in these the staphylococcus and streptococcus have been found (Koplik). The most probable conclusion in such cases is that there may have been some element, such as an exposure or traumatism, which favored the invasion of the pleura through the lungs. In many cases we could assume, in spite of the absence of the streptococcus lanceolatus or Fraenkel's diplococcus, that a broncho-pneumonia might have existed, and the staphylococcus or ordinary streptococcus, which always exists in these cases in the lung as a mixed infection, may have gained access to the pleural cavity to the exclusion of the primary excitant, the diplococcus pneumoniæ.

In many pleuritic effusions, both serous and purulent, the most careful examination of the exudate fails to give any microbic elements, and in these we are left to surmise the etiology. The serum and pus of such cases have been injected into animals without arriving at any satisfactory conclusion. It is possible that a proportion of these cases are tubercular, but it would be a very extreme view to assume that all those cases of pleuritic effusion in which no micro-organisms are found are tubercular. For this is at variance with clinical experience. Many of these negative exudates have been assumed to be due to acute primary pleurisies brought about by cold, exposure, or trauma. The clinical regularity with which an exposure or traumatism can be shown to have been followed by pleurisy leads us to assume that, though of itself it may not be able to produce inflammation of a structure, it can so devitalize a part or organ as to make the latter a ready prey to the action of microbic

agents. On the other hand, we know that in the healthy individual the upper air-passages are the seat of micro-organisms which, isolated from their habitat, are pathogenic (the streptococcus of sputum). Yet in the healthy unexposed individual these micro-organisms are harmless. We thus have that class of pleurisies in which the staphylococcus of various kinds and the chain coccus have been found, as well as part of the class in which no micro-organisms have been established, as still to be more satisfactorily elucidated.

The question of *primary pleurisy* in children is also very difficult to approach. We know of pleurisies which, clinically, are very acute in onset, and in which the effusion within twenty-four hours reaches such an extreme gross quantity as to cause by its presence alone quite serious symptoms. In these cases the effusion may be serous, or it may from the outset be purulent. In many of them no previous history of lung trouble or any traumatism or exposure has preceded. These are the cases which have been described as *acute primary pleurisy*. While allowing the former classification to stand, the writer must express his conviction that future work will reveal some primary etiological factor outside the pleura itself. The pleural cavity is such an isolated space, much like the joints, that it is difficult, in the light of our present knowledge, to conceive of its primary inflammatory reaction similar to that taking place in the lung in pneumonitis.

In the septic pleurisies the micro-organism which has been found in children is the streptococcus, probably the streptococcus pyogenes (Koplik). In the tubercular pleurisies, whether the effusion be serous or purulent, the tubercle bacillus can be found, but only with great difficulty. In many cases, as has been shown by Ehrlich, it is absent. In the purulent exudates the staphylococcus and streptococcus may be found as mixed infections, or they may be absent.

Symptoms.—There are two distinct sets of cases in children: those with an acute and those with an insidious onset. If the invasion be acute, we have a picture which differs but little from the onset of a pneumonia, and as in the majority of cases such a pulmonary process is coexistent, it is easily seen how the symptoms of one condition may be masked by the other. A chill is the rule only in older children, while in infants cerebral symptoms, convulsions, or stupor may usher in the disease. The fever is quite high—103° to 105° F.; and the pulse very much increased—to 140, sometimes 180 beats. There is marked dyspnœa, and even in infants the face has an anxious expression. The urine is diminished, and in the course of a few days we have all the symptoms—dryness of tongue, loss of appetite, and prostration—which accompany any acute disease with fever. The cough, which may be present from the beginning, is distressing, for the infant cries whenever it coughs; but, as is the rule in infants and children of all ages, there is no expectoration. After the acute symptoms have subsided a slight elevation of temperature may persist, with a *remittent* curve, sometimes only about one-half degree above the normal, with an evening rise of one or two degrees, but never quite reaching the normal. This, with dyspnœa and pain, though less than at first, and more infrequent cough, continues the clinical picture during the subacute stage. The effects of the illness are shown by pallor instead of the febrile flush of the onset, and, if the case continue without relief, even for two or three weeks, by marked emaciation, especially in those patients suffering from a purulent exudate.

In the other class of cases the onset is more insidious. The child may have at first a marked febrile movement for a few hours, and as this passes away it is apt to disarm suspicion. The child is not quite well; it has a remittent

curve of febrile movement, and, if older, will complain of occasional pain in the side. The cough may be so slight as to be unnoticed. Yet the increasing pallor, languor, and evident illness will bring the patient to the physician, who will not suspect a pleurisy unless a systematic physical examination reveal fluid in the chest.

The fever is, in most acute cases, high in the beginning, and, though it is not uniformly so from day to day, it still reaches in some cases a maximum of 105°, and then may remit a degree or two. When pleurisy is accompanied by pneumonia, the temperature, as in this disease, continues uniformly high, 103° –105° F., until the eighth, ninth, tenth, or thirteenth day, when a fall will occur with an attempt at crisis. At this period the axillary temperature may reach 99°–99.5°, but it will not fall to the normal level. In the following days, should the pleurisy continue, as in most of these cases it does, the curve begins to rise gradually to 101° or 102°, and will remit in the morning. These cases are quite characteristic. In dry pleurisy without effusion there is scarcely any fever.

The pulse is accelerated, being sometimes as high as 180, and especially so in paroxysms of coughing. The tension varies, but in children the heart, though pressed upon by effusion, generally is equal to the new condition in the chest. It is only in fat, flabby children and those suffering from dyscrasiæ that, with a rapidity and threadiness of pulse, even from the outset, we notice instead of the usual flushed appearance a pallor of the skin and a cyanosis of the mucous surfaces, as of the lips.

Dyspnœa is generally the most apparent symptom in children. The dilated nostrils and the drawing inward of the infrasternal region both indicate a disturbance of the respiratory function. When the chest is touched, pain is evinced by uneasiness and greater dyspnœa. The mother will say that the child cries when taken hold of under the arms in the usual way. The babe will favor the side affected by lying upon it, and suckling the left breast, if the right side be the seat of trouble (Henoch). Older children will sometimes indicate the portion of the chest in which the pain is located; in other cases they will mislead by indicating the epigastrium or abdomen as the seat of pain (diaphragmatic pleurisy).

The cerebral symptoms not only mislead, but may puzzle the physician for days, until the effusion becomes large enough to detect. These symptoms resemble those in pneumonia—convulsions, somnolence, vomiting, in older children cephalalgia and epileptiform seizures.

Physical Signs.—*Inspection* of the chest in children who suffer from any form of pleurisy, whether effusion be present or not, reveals a lack of movement on the affected side. This is quite apparent in even very young infants, and is in striking contrast to the motion of the opposite side in all the various grades of dyspnœa which may be present in individual cases. If there be a quantity of exudation or fluid in the chest, there is, in addition to lack of motion, a very marked bulging of the affected side. By this is meant bulging as a whole. The individual intercostal spaces do not always bulge in infants. On the contrary, the chest may be full of fluid, and a retraction of the spaces, increasing on inspiration, may exist. It is of little practical value to calculate the amount of increase in circumference of the affected side. This will vary with the amount of fluid present.

Palpation reveals but little if the form of pleurisy be dry and the effusion slight. On the other hand, if the effusion be considerable, a most valuable sign is furnished by the complete absence of vocal fremitus in older children. In infants the absence of the cry-fremitus gives evidence of the same con-

dition. This is one of the most constant signs of pleurisy with effusion in children, where, above all other things, the physical signs to be detailed are constantly varying. It has been the practice of the author to rely largely upon fremitus and a certain resistance to percussion, which will be noted later, in deciding upon the presence of an effusion. If the healthy side be the seat of bronchitis, a peculiar râle-fremitus may be felt on this side, but this is only of negative interest.

Percussion.—The percussion-note over thickened pleura is dull; over fluid, flat. But, as has been hinted, in children these signs show the most marked variation. There is nothing characteristic in the signs obtained by percussion. The chest in an infant is so resilient that much depends upon the force used and the skill of the examiner to bring out the requisite note. A layer of fluid may exist between the lung and the chest-wall, and skilful percussion will reveal dulness, while more forcible percussion brings out the pulmonary note of the underlying lung. If the chest be filled with fluid, the note will be flat; and this is another reliable sign. In chests where the fluid fills out the lower portion of the pleural cavity the pulmonary resonance will be obtained above, while below there will be noted dulness varying to flatness, depending upon the thickness of the layer of fluid between the lung and the percussing finger. *The resistance to the percussing finger is peculiarly wooden in character*, especially in children. The resonance upon the unaffected side of the chest is increased, and sometimes tympanitic.

Auscultation may reveal râles or friction-sounds, bronchial voice, and bronchial breathing, or all these may be absent, the breathing being simply puerile and the voice but little changed. Nothing is so deceptive as the auscultatory signs in pleurisy. If no effusion be present, we hear friction-sounds in children resembling for the most part the fine crepitations of pneumonia, and even when the chest is full of fluid these crepitations may be quite loud. These may be confined to small areas in dry pleurisy, or in pleurisy with effusion may be diffused over the whole chest. This is what tends to confuse the examiner. The voice in dry pleurisy is not changed. In pleurisy with all varieties of effusion the voice may be *normal*, even when the chest is full of fluid. Again, as stated, it may be bronchophonic. The breathing may be heard above the level of fluid, and be diminished, absent, or bronchial, below. Again, breathing may be heard with equal distinctness over a side which is full of fluid, as over the unaffected side. In most cases we must rely mainly upon fremitus and percussion.

In children sometimes, though rarely, the fluid will not appear in front of the chest, though it exists over the whole side posteriorly. The lung seems to have been pushed up and forward, instead of against the spinal column. In such cases increased respiratory murmur and tympanitic resonance will be obtained over the apex of the lung in front.

It is quite common to see the routine remark that displacements of viscera, notably of the liver and heart, are common in children suffering from pleurisy with effusion. This is not strictly true. In young children, where the chest is very easily expanded by the accumulated fluid, the effusion must be exceedingly large before downward displacement of the liver will be appreciated. Older children also may carry large amounts of fluid without marked displacement of the liver, though it can, in some cases, be distinctly noted. In younger children effusion upon the left side may displace the apex of the heart toward the sternum, but this is not apt to occur, except as the result of very large effusion. In the adult the displacement of the liver in right pleurisy, and of the heart in left, is quite a constant sign.

In conclusion, the author would lay stress upon the immobility, bulging of the affected side as a whole, lack of fremitus, and flatness, combined with a peculiar resistance to the percussing finger, as the leading reliable signs of acute chest effusion, which may be corroborated by change in the voice and breath-sounds. In children, as in adults, the effusion of pleurisy accumulates in the most dependent part of the thorax, behind, adjacent to the vertebral column. In children 100 grammes of effusion can be thus discovered by percussion at the lower and inner portion of the chest-wall, adjacent to the spine (Gerhardt; Piorry). Accumulation of the fluid takes place thus in an oblique area, growing deepest toward the median and tapering at the axillary line. Small effusions in meta-pneumonic pleurisies may be encapsuled and give a localized area of dulness or flatness. In tubercular pleurisies this is also very often the case. In infants and young children the fine distinctions of change of position of small exudates can hardly be made out, as in the adult, on account of the restlessness of the patient.

Diagnosis.—The diagnosis of pleuritis in children is not difficult in the majority of cases, but there is a percentage in which care must be exercised before diagnosis can be positive. Dry pleurisy is diagnosed by the presence of pain and the physical signs of local dulness and friction-râles. Localized encapsulated pleurisies must be diagnosed by the circumscribed dulness or flatness and the change of fremitus over a circumscribed area, with perhaps a change in the voice and respiratory sounds.

If an effusion be of considerable size, the diagnosis is difficult when the layer of fluid is so thin as not to mask the pulmonary resonance and give only dulness; but even here the fremitus will be absent. In marked effusion the complete loss of fremitus, immobility of the affected side, and flatness, with a certain wooden resistance to the percussing finger, are quite characteristic. It is well not to rely too much upon vocal resonance or respiratory murmur. In order that an effusion may not be overlooked, it is important to think of the possibility of its existence in every case, and to exclude it only after careful examination. It is of little moment if a delay of twenty-four or forty-eight hours occur when the symptoms are not of a pressing character. But every practitioner sees cases in which fluid must have been present for weeks without being recognized. In children the exudate at a very early period, even from the onset, is likely to be purulent, and it can be easily seen how important it is to discover the character of an exudate as soon as possible. Aside from pressure effects, the presence of a purulent exudate is dangerous on account of its tendency to burrow inward toward the lung, eroding the pleura, or to rupture externally.

If there be doubt as to the presence of fluid or as to its nature, these facts should be determined as soon as possible. For this purpose a hypodermic exploring needle should be used in the following manner: The mother holds the babe in her arms in the usual way, the posterior part of the chest is bared, and the area of most complete dulness or flatness is determined. This part is first washed carefully with alcohol, and then with corrosive sublimate (1 : 5000). A long exploring needle, a little larger than the ordinary hypodermic needle, but stronger and stouter, having been attached to a well-cleansed hypodermic syringe, is rapidly driven into one of the intercostal spaces, the higher the better. On the right side, where the liver will present itself to the entering point of the needle if too low, the puncture should not be lower than the eighth space, in line with the angle of the scapula. The chief point, however, is to enter at the area of greatest dulness or flatness. Having pushed in the needle about one-half an inch, the piston of the syringe should be drawn.

The whole operation should be rapidly done, and the mother should be warned to hold the child firmly, for any sudden movement might cause the needle to impinge against the rib and break off—an accident which has occurred. This little operation should be over before the child has ceased to experience the pain of the entry of the needle. If no fluid be found the needle is rapidly withdrawn and a piece of rubber plaster placed over the point of puncture. The author has never had an accident in many such operations, and it requires but ordinary cleanliness and care. It secures to the patient the benefit of an absolute diagnosis.

Sometimes we may be absolutely certain of fluid, and yet be unable to prove it with the needle. In such cases the needle has entered an adhesion of the pleura, and at the next sitting, if still in doubt of the diagnosis, the needle should be entered at another point. It is unwise after inserting the needle to thrust it up and down the chest-wall or pleural space. In this way the lung may be wounded, and emphysema, hæmorrhage, or irreparable injury be caused. While the needle is in the chest it should be held so lightly that any sudden unexpected movement on the part of the child will not afford leverage to the needle against the rib, for if this occur the needle is apt to break. When fluid is obtained its character should be carefully determined, and the presence and significance of contained bacteria should be investigated. The busy practitioner may not have time to do this, but the author has devised a very simple bulb[1] for the withdrawal and transportation of such fluids.

As far as prognosis and even treatment are concerned, it is of self-evident importance to determine as early as possible whether an exudate is pneumonic, tubercular, or doubtful. The presence of chain cocci, staphylococci, or the diplococcus pneumoniæ in a serous exudate will prepare the physician for the advent of a purulent effusion, and the practical knowledge thus gained may be of vital importance to the patient's future happiness.

In the presence of a suspected effusion it was previously, and still is among some, the custom to temporize. It was argued that an exploring needle was likely to cause a serous fluid to become purulent through the entrance of air or some few micro-organisms. But the most ordinary cleanliness will render this almost impossible. The author doubts very much if an effusion was ever changed in character by careful hypodermic exploration. A slight amount of air, or a few staphylococci, if through some carelessness introduced into a serous exudate on the point of a needle, can scarcely change the character of fluid filling the chest. The serous portion of exudates, like those in joints, hydroceles, etc., is actually capable of annihilating the life of micro-organisms in fixed ratio (Buchner; Prudden). Moreover, serous effusions, formerly thought to turn purulent through some accident, are really purulent and contain the microbic element of pus from the outset, although they appear serous to the eye. While advocating caution, the author recommends a fearless resort to so valuable a guide as the hypodermic exploring syringe.

The tubercular cases alone offer the greatest difficulties of diagnosis, for, as has already been shown, some serous and purulent exudates which contain no micro-organisms may be tubercular, as may even those that contain staphylococci or streptococci. But, fortunately, in children tubercular pleurisies are not the most common forms. Hæmorrhagic pleuritic exudates are very rare in children. They are generally caused by grave disease—tuberculosis, sarcoma, carcinoma, or morbus Werlhofii.

The cases of pneumonia which are complicated with pleurisy are the most trying to the practitioner. Here on the eighth, ninth, tenth, or thirteenth day

[1] *American Journal of the Medical Sciences*, 1892.

no complete crisis takes place. The temperature falls to within even one-half of a degree of the normal in the axilla, but dulness persists in the lower part of the chest or flatness appears over its whole extent. This condition is frequently mistaken for so-called unresolved pneumonia.

Prognosis.—In children the prognosis in pleuritis is good. In the form occurring after pneumonia or that caused by the staphylococcus or streptococcus (non-septic), with effusion into the chest, recovery is rapid as soon as the fluid is evacuated, and much depends upon early diagnosis. In suppurative pleurisy, if allowed to remain unrelieved the pus will burrow, usually externally. The effusion then may infiltrate the soft tissues of the thorax, after eroding the pleura, and point as an abscess at the side anteriorly or posteriorly. Sometimes such an exudate, when on the left side, may receive an impulse from the heart, and thus is occasioned the so-called *pulsating pleurisy*. Such effusions have been mistaken for aneurisms, but lack of expansile pulsation and the history of the case will guide in the diagnosis. The tumor disappears when the chest is aspirated. If the pulmonary pleura becomes eroded by a purulent exudate, the perforation takes place into the lung, and the pus is more or less quickly expectorated. Even in such cases, though unrelieved by any additional measure, recovery has taken place, as in a case elsewhere recorded by the author. Tubercular pleurisies do not recover completely in children; fistulous suppurating cavities with retraction of the chest result. In some cases the pleurisy has been so extensive as to cause retraction of the lung, its utility being impaired by the binding of thick pleural plates, which leave behind a large suppurating pleural sac. The septic cases are, as a rule, fatal, though in fortunate instances recovery takes place.

Hofmokl treated by resection 60 cases, in which recovery was complete in 26. Twenty-eight cases were fatal; 13 of these were tubercular, 6 were complicated with pneumonia, 3 died through pericarditis, 3 with peritonitis, 1 with amyloid degeneration of the organs, 1 with heart failure, and 1 with neoplasm. These cases were evidently more unfavorable, as to general character of the pleuritis, than is common.

Complications.—The most dangerous complication of pleuritis is pericarditis, which in most cases is fatal. The occurrence of lobar or lobular pneumonia as a complication has been dilated upon elsewhere. The septic cases may be complicated by endocarditis or suppuration of other serous surfaces, such as the peritoneum or that of the joints. Gangrene of the lung may cause severe putrid inflammatory reaction of the pleura, and thus the pleural cavity may contain gases with purulent exudation (pyopneumothorax). In these cases a peculiar physical sign, known as the succussion sound, may be elicited by shaking the patient.

Sudden death from heart failure may occur, but this must be rare. The right heart, however, may become weakened to such an extent as to allow the formation of thrombi, and their entry into the circulation may cause sudden death.

Contraction and retraction of the chest-wall always follow, to a certain extent, in those forms of pleuritis which have been left to nature. Many of the deformities of the chest observed later in life are due to pleuritis in childhood.

The perforation of an empyema into the lung, with its evacuation through a bronchus, has already been referred to as having rather a favorable prognosis, even when not relieved by operation. As a rule, however, such cases are best treated by external incision, although evacuation may be expected by the bronchus. Again, perforation may take place through the chest-wall;

here a large boggy infiltration of the tissues of the chest or adjacent abdominal wall takes place, constituting the condition known as *empyema necessitatis.*

Treatment.—It is difficult to formulate methods of treatment of pleuritis, a disease in which the successful issue depends greatly upon judgment founded upon experience. Those cases of pleuritis in which the process is circumscribed, and in which the effusion in the pleural cavity is but slight, have pain as the main symptom. The fever is generally marked, and requires, as a rule, but ordinary methods. In children the pain is best relieved by some mild opiate, like Dover's powder in proportionate dosage, or in combination with phenacetin and salol. The latter has the advantage of controlling to a degree the febrile movement. The author has seen but little advantage from the time-honored application of iodine to the chest, nor has he seen much result from the internal administration of the iodide of potassium. The latter is apt to disturb the stomach, which at this time has largely to be depended upon to maintain nutrition. The author would also advise against the use of external blisters of all kinds, if for no other reason than the unnecessary pain which these agents cause, and from the danger of infection in a weakened constitution if the skin be broken.

When there is a moderate effusion of a serous character, even though this effusion contain *micro-organisms*, yet if there is still no tendency to turbidity, it is quite proper to make an attempt to favor absorption. Therefore, without weakening the patient, care should be taken that the bowels are freely opened from day to day, while the strength of the heart must be maintained. The most useful combination of drugs in these cases is one of digitalis and calomel. There is undoubtedly a very firm foundation for the belief that activity of the kidneys will diminish a pleural effusion which is not due to renal or cardiac disease. The fluid extract of digitalis should be used, in proportionate dosage, in a separate mixture, whereas the calomel may be used in powder form. The author generally gives both together. The supporting effect of digitalis upon the circulation is aided by the diuretic effect of the calomel. Large doses of the latter drug are unnecessary; small doses should be used at first and increased, given at three-hour intervals. Salivation, or even dosage to its limit, is injurious.

Where the chest is full of an exudate which is quite clear, but which causes few symptoms of pressure, absorption may be hastened by aspiration of a small quantity to begin with, trusting to drugs and nature for the rest. In children this is rarely necessary, so quickly does the circulation, if supported, respond to the demands made upon it. There are cases of pleurisy in which a clear serous exudate of a pneumonic character may increase so rapidly and cause such dangerous dyspnœa and pressure effects, that within a short space of time it may be necessary to relieve the patient by aspiration. Even when aspiration is effectually carried out, in some cases reaccumulation at once occurs. Such exudates are not turbid, but clear, and may contain micro-organisms. If reaccumulation occur in spite of diuretics, the question of a radical procedure always presents itself. The author must support the view founded upon experience, that such cases can be most effectually treated by permanent drainage. The operations which are at our disposal for this end will be taken up later.

From this it will be seen that the author regards aspiration as a palliative measure, after the performance of which the little patient must be watched as closely as before the operation. In children aspiration does not bear the same relative therapeutic value in pleuritis that it does in the adult. Its immediate performance entails as much care, causes as much anxiety, as a more radical

procedure, and with less satisfactory results. In most cases not only does reaccumulation occur, but the effusion, at first serous, becomes purulent—not because it has been infected by aspiration, but rather through the progress of the pleuritis, as previously explained. Radical procedure may therefore be required in rapidly reaccumulating serous exudates, causing pressure effects, whether these contain micro-organisms or are free from such.

In small and large purulent exudates absorption rarely occurs spontaneously. To temporize with a purulent exudate is to harm the patient. With purulent exudates we include also those serous exudates which were formerly treated expectantly: they are slightly turbid, and contain, to the eye, a few flocculi, but, if examined bacteriologically and microscopically, will be found to contain leucocytes and micro-organisms. To temporize with such so-called serous exudates is to be finally disappointed in finding them more distinctly purulent after a short period. In formulating diagnoses we must remember also that exudates which are in part purulent tend to separate into a serous layer above and a thick purulent layer below. Our needle may withdraw serum from a chest which contains a fully-developed purulent exudate.

In the *simple aspiration* of the chest we should be guided by the case, and with our needle avoid the proximity of vital organs. The sixth space in front, the seventh in the axillary line, and the eighth behind are those generally selected. Yet sometimes, fluid being low in level, a change may be demanded. The point of the needle should enter near the upper border of the rib, and should not be passed too deeply into the chest for fear of wounding the lung.

The operative procedures which may be considered to be radical in their nature, and which now have the confidence of clinicians are—incision, with insertion of drainage-tubes; siphonage of the pleural sac; excision of the ribs with insertion of drains.

Incision.—This operation is practised in the fifth space if in front, in the sixth in the axillary line, and if behind, the ninth space is chosen. König advises the higher point. Behind and on the right side we consider the presence of the arch of the liver. The incision is made near the upper border of the rib, 5 to 8 cm. long.

This operation is popular with the practitioner, because it involves but little technical skill, and once the incision is made, a drainage-tube is easily inserted. In children, however, where the intercostal spaces are narrow, surgeons do not look with great favor upon simple incision, for the reason that it is difficult to retain a tube of any great size in the wound. The opposing ribs are constantly pressing the sides of the tube together, and in this respect the drainage is imperfect. Moreover, the constant movements of the patient and the chest are apt to dislodge the tube completely, and in the intervals of dressing the wound the opening into the pleural cavity becomes distorted, so that attempts to replace the tube give much pain or even fail completely. Many cases will, however, do well with simple incision; yet the fact remains that in other cases a secondary operation, which has for its object the removal of a piece of rib, has to be performed in order to obtain drainage. The author has seen cases treated by incision, and thought to have recovered, in which reaccumulation occurred after removal of the tube, and necessitated a secondary resection of the rib.

Resection.—In all cases of purulent exudation it saves much of the strength of the patient if efficient drainage be obtained from the outset. This is secured by the operation of resection of one of the ribs of the affected side. In this way sufficient space is obtained for the insertion of a drain of considerable size, but

this drain is not pressed upon by the adjacent ribs, and is not generally displaced, or, if displaced, is easily readjusted.

The seventh, eighth, ninth, or tenth rib is chosen, as demanded by the individual peculiarities of each case. The skin incision is made about 10 cm. long, and 4 to 6 cm. of the rib is taken away with the bone forceps, after carefully reflecting the periosteum. The opening is then made into the pleural space—through the periosteum, or by a separate incision which passes through the intercostal space below. The latter saves the whole periosteum intact, and ensures reproduction of the bone without the least deformity. As in simple incision, the opening may be made in the axillary or post-axillary line, or behind in line with the angle of the scapula. On the right side the incision for resection should not be made too low, as the arch of the liver will eventually interfere with the retention of the drainage-tube. After the rib has been resected and an opening made, some operators introduce the finger and break up adhesions between the lung and chest-wall to free any encapsuled collections of pus which may be present. This is to be deprecated, because in unskilful hands the lung itself is apt to suffer injury.

Irrigation of the cavity is not necessary either at or after the operation. Such a procedure may cause fatal syncope, or, if not attended with accident, certainly does tend to prolong inflammatory processes going on in the chest. Moreover, on account of the retention of some of the irrigating fluid, an exudate at first of good character may become putrid.

In those suppurating pleurisies which, from various causes, such as the perforation of a gangrenous or tubercular pulmonary focus, become putrid, or have from the first been putrid, irrigation at long intervals with Thiersch's solution or simple boric-acid solution or permanganate of potash is admissible.

Resection of the rib has of late been confounded with Estlander's operation. The latter operation is one undertaken to secure retraction of the chest-wall against a crippled lung, and should not in any way be associated with the comparatively simple procedure of removing an inch or so of one rib to give space for the insertion of a drain in ordinary acute purulent pleurisies.

Though much has been said on the subject of valvular drains (Phelps), which prevent the entrance of air into the pleural cavity, and are supposed to favor expansion of the lung while securing complete drainage, there seems to be little gained by their use. In the ordinary suppurating pleurisies the customary surgical dressings seem to answer very well in taking up and keeping aseptic any purulent discharge from the pleural cavity. The free filtration of air into the pleural sac is not attended with any ill effects. It is difficult to conceive how a discharge can become putrid from the admission of air alone into the pleura. There must be other elements present to cause such a bad result; and these will be found in ineffectual drainage with retention of old discharges in the pleural sac, or in some necrotic focus adjacent to the pleura and opening into it.

It was formerly customary to make counter-openings in the chest to favor drainage, but this has been found to be undesirable.

Siphonage.—To some the operation of resection will always be a grave procedure, and there has been a constant effort to find some substitute which would be more satisfactory than simple incision, yet not so complicated as resection. This has resulted in perfecting an operation which depends on the principle of siphonage, through negative pressure, to drain the pleural cavity. The Buelau operation, to which reference is made, consists of the introduction of a drain through an opening in the intercostal space; this

drain is connected with tubing which empties into a siphon-bottle, under the surface of an antiseptic fluid.

The operation requires (*a*) a trocar exactly 6 mm. in calibre, fitted with a canula; (*b*) a new disinfected Jacque catheter, fitted accurately to the canula, and passing through its lumen with ease, yet not loosely; (*c*) attached to this catheter, by means of glass tubing, a rubber tubing 75 cm. long.

A small incision is made in the skin of the intercostal space, where the trocar is to enter. The trocar and canula are then inserted, the trocar withdrawn, and the Jacque catheter, with its blunt extremity cut squarely off, is introduced for about 15 centimetres into the chest. The canula is now withdrawn over the Jacque catheter, escape of chest-contents being for the time prevented by pinching the catheter. The catheter is now connected with the tubing, which is led into a bottle filled one-third with an antiseptic fluid. The pleural exudate thus escapes into the bottle beneath the layer of antiseptic fluid, and air is prevented from entering the chest. Among the advantages claimed for this operation by its advocates are its simplicity and the prevention of entrance of air into the pleural sac. The negative pressure in the pleural sac is also maintained, and the siphonage favors expansion of the lung. The siphoning exudate is under constant observation through the glass tubing and bottle, and when recovery sets in its advent can be noted by the cessation of the discharge. There are no dressings except the adhesive plaster, which retains the catheter in the chest. The results of this operation, especially with children, in the hospitals of Hamburg have been so gratifying as to make certain surgeons there its enthusiastic advocates. Scheede, on the other hand, fears that unruly children will displace the tube in the chest. The advocates of the siphon method maintain that this is not likely to happen. Their results are certainly equal to those of surgeons using other methods, and should bring the operation into favorable notice.

PULMONARY EMPHYSEMA.

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New York.

Pulmonary Emphysema is an abnormal accumulation of air within the vesicles or in the extravesicular connective tissue of the lungs.

The varieties of this malady are—I. Interstitial, interlobular, or extravesicular emphysema. II. Vesicular or alveolar emphysema, subdivided into *a*, compensatory or vicarious emphysema; *b*, substantive, idiopathic, or hypertrophic emphysema. III. Atrophic emphysema. As this last form occurs only in advanced life, no further allusion will be made to it here.

I. Interstitial Emphysema.—In this condition there is an accumulation of air in the connective tissue of the lung. It is usually the result of some violent expiratory effort, such as would occur in a severe case of pertussis. When the escaped air extends beneath the pleura, small air-bubbles appear on the surface of the lung, showing the outlines of one or more lobules. Sometimes large bullæ are seen. In unusual cases the air may burrow along the larger bronchi into the mediastinum and up into the subcutaneous tissue of the neck. Interstitial emphysema, as a rule, gives rise to no symptoms, and unless it extend to the neck is not a serious malady.

II. Vesicular or Alveolar Emphysema.—*a*. Compensatory Emphysema.—As the term would imply, this is a condition in which the vesicles of one portion of the lung are abnormally distended in consequence of the crippling or non-expansion of some other part of the organ.

Etiology.—It is this form of emphysema rather than the substantive form that is to be observed in young children. Indeed, cases of typical substantive emphysema are extremely rare in early childhood. In the genesis of compensatory emphysema there probably exists in most of the cases as a predisposing factor a defect in the nutrition of the pulmonary tissue. Thus with the same exciting causes in operation it is much more likely to occur in rachitic subjects than in children whose nutrition is perfect. The immediate causes include any mechanical obstruction to free respiration that would give rise to increased pressure within the vesicles. In protracted bronchitis, particularly when the finer bronchial tubes are affected, the swollen mucous membrane and the accumulation of viscid mucus interfere with the entrance of air into the corresponding lobules, causing a partial or complete atelectasis of the parts involved. This will leave an unoccupied space in the chest-cavity which becomes filled by the hyperdistention of adjacent lobules. This is the inspiratory theory. Again, as is so often observed in pertussis, in consequence of obstruction to the free egress of air through the glottis with extra-violent expiratory efforts, the retained air is forced in the direction of the least resistance, the apices and anterior borders, causing an over-distention of the vesicles in these regions —the expiratory theory.

In the vicinity of solidified areas of lung-tissue, as in pneumonia or tuber-

culosis, emphysema is usually discernible. When one lung is compressed by fluid in the pleural cavity, the other lung by reason of its increased function becomes over-expanded. Pleuritic adhesions that prevent the normal expansion of the apex and posterior border of the lung necessitate over-distention of other parts of the organ, especially the anterior and inferior borders.

In addition to other complications, emphysematous distention of parts of the lungs is to be found in membranous croup. In advanced rachitis the pliability of the ribs and costal cartilages favors the development of emphysema in the anterior margins of the lungs.

Inflation of the lungs in the asphyxiated new-born child by blowing into its mouth has been said to give rise to emphysema. Such a cause must be quite exceptional, judging from the manner in which lungs that have been removed from the body collapse after forcible inflation.

Pathology.—In the majority of cases of compensatory emphysema complicating acute bronchitis and pertussis recovery evidently takes place. In these cases there has undoubtedly been simply a hyperdistention of the pulmonary air-vesicles without any structural changes in their walls. The same may be said of the inordinate inflation of the lung of the non-affected side in acute pleurisy with effusion, where there has been a rapid absorption of the accumulated fluid. Where the affection is associated with tuberculous infiltration or old pleuritic adhesions, dilatation of the air-vesicles, with thinning of their walls and other structural changes characteristic of substantive emphysema, may be found to exist. From this we may conclude that the longer the duration of the immediate causes of compensatory emphysema, the more likely is a true emphysema to develop.

Symptoms.—A diagnosis of compensatory emphysema cannot, in most instances, be made either from the symptoms or by physical exploration of the chest. In fact, there are no distinctive signs of the affection unless considerable of the lung be involved, and its existence is generally assumed. Bulging of the supraclavicular space during the severe expiratory efforts of coughing, and a falling-in during inspiration, have been regarded as indicative of an involvement of the apices. Where one side of the chest is filled with fluid the hyper-resonance of the opposite side with the exaggerated vesicular murmur would suggest the belief that the one lung is performing the work of the two, and that the vesicles are abnormally distended. If extensive pleuritic adhesions exist, a prolonged low-pitched expiratory murmur may be heard over certain portions of the lung, but especially at the anterior border. In this latter situation the same character of respiration may be detected in rachitic subjects with marked chest-deformity.

Treatment will be considered under Substantive Emphysema.

b. Substantive Emphysema.—This is a chronic and generally incurable malady, characterized by an abnormal distention of the pulmonary vesicles, with structural changes in their walls.

Etiology.—Well-marked substantive emphysema in young children—that is, under the age of ten years—is extremely rare. After this age it is occasionally observed, but not until adolescence is it encountered with any frequency. Authorities differ materially in their views regarding the causation and nature of this disease. From the frequency with which it is found to run in families it would, in a measure, appear to be of an hereditary nature. Jackson investigated 28 cases, and found that 18 were born of parents one or the other of whom had suffered from emphysema. Greenhow collected 42 cases, 23 of which appeared to be of an hereditary tendency. The histories of many cases of emphysema in the adult show that there have been frequent respiratory

affections from early life; still, in other instances where the disease has been extensive, no account of previous attacks of bronchitis can be elicited.

Increased air-pressure within the pulmonary vesicles, due to forced and long-continued inspiration or expiration, is by some investigators considered at least the exciting, if not the primary, cause of emphysema.

According to the inspiratory theory of Laennec as modified by Hutchinson, Traube, and Gairdner, emphysema is a result of bronchial catarrh. The presence of a tumefied mucous membrane and viscid mucus in the bronchioles prevents the entrance of air into the corresponding lobules, giving rise to areas of collapse, and to fill up the deficiency so caused the neighboring lobules become hyperdistended.

The theory of expiration as maintained by Jenner and Mendelsohn would seem to afford a more adequate explanation, than does the inspiratory theory, of the part mechanical distention of the air-cells plays in the production of substantive emphysema. During forced expiratory efforts with a closed glottis, as occurs in violent attacks of coughing or severe straining, the air is driven in the direction of the least resistance—namely, the apices and anterior borders of the lungs. It is in these situations that the greatest degree of dilatation is usually found. There are cases, however, where the disease is diffused throughout the lung, without a history of previous cough or increased expiratory pressure.

C. J. B. Williams claimed there was a fatty degeneration of the lung-tissue that aided in bringing about the pathological changes observed in emphysema. Fatty matter has been found in only a small number of cases. Jenner taught that the most frequent anatomical change in the lung was fibrous degeneration resulting from slight but long-continued congestion.

Delafield believes substantive emphysema to be a chronic inflammation of the lungs, a pneumonia, and the dilatation of the air-vesicles a mere result of this inflammation, and not the essential lesion: the inflammation, he states, is of the same type as that which so often attacks the endocardium, the inner coat of the arteries, the liver, and the kidneys—a chronic inflammation attended with the production of new fibrous tissue, and at the same time with atrophy and disappearance of normal tissue. It is quite evident that increased air-pressure within the vesicles does not exclusively account for the presence of substantive emphysema. Indeed, it seems doubtful if it can be considered as anything more than an exciting cause or as aggravating the disease when it has already been established. We think it may reasonably be inferred that children who suffer with frequent prolonged attacks of bronchitis are likely to become the subjects of emphysema later in life, not only because of the pulmonary disturbance induced by the increased intralobular pressure, but on account of the existing condition which predisposes the child to the repeated bronchial catarrhs; for in such children there is unquestionably a vulnerability of the tissues the outcome of some defect in the nutrition.

Pathology.—In the rare cases of substantive emphysema that occur in early life most of the changes that are to be observed in the adult are present, only in a less degree. On opening the thorax the lungs do not collapse. They have a peculiar cushiony feel and pit on pressure. The color is pale grayish or yellowish gray. The air-vesicles present varying degrees of dilatation. Their walls are in some parts of the lung thinned, in others thickened. Coalescence of neighboring vesicles and obliteration of the capillaries occur in some instances. The epithelium of the air-cells presents degenerative changes. In the bronchial tubes may be seen evidence of chronic bronchitis, with dilatation of the bronchioles in some advanced cases. There may be some hyper-

trophy of the right ventricle, and less frequently a secondary dilatation. The secondary lesions of emphysema do not usually occur until long after childhood.

Symptoms.—Substantive emphysema not infrequently is present in the adult without giving rise to any subjective symptoms. This being the case, the more abundant reason there is why, with its less extensive development, it may exist in the young subject without thus manifesting its presence. When rational symptoms are present, they resemble, in a milder form, with the exception of those dependent upon secondary lesions, which are absent, those observed later in life.

Dyspnœa is probably the most marked symptom. At first it may be experienced only during unusual exercise; later, it becomes more constant, and is aggravated by even slight exertion, attacks of bronchial catarrh, and by distention of the stomach by a hearty meal or by the accumulation of gas from indigestion. Asthmatic attacks are of not infrequent occurrence. Off and on during the winter there is more or less cough.

Physical Signs.—*Inspection.*—The typical barrel-shaped chest of emphysema is seldom observed in children. There may, however, be a slight increase in the antero-posterior diameter. This will be more noticeable when associated with rachitic deformity of the thorax. Posteriorly, the curve of the spine may be increased, giving the back a rounded appearance. This must not be confounded with rachitic curvature of the spine. There is some increased exertion in respiration, but the rigidity of the chest, due to ossification of the costal cartilages, seen in advanced adult cases is absent. There may be some retraction of the upper abdominal region, owing to the powerful action of the diaphragm on the lower ribs. Jenner has observed falling in of the supraclavicular region during inspiration in cases where the apices were affected. Fürst considered expansion of this region during severe cough as a characteristic sign.

Palpation is negative.

Percussion.—Pulmonary resonance may remain unaltered. In older children, when it is changed, it is of a vesiculo-tympanitic quality. In young children the great elasticity of the thoracic walls and the smallness of the organs to be examined favor the transmission of resonance from the distended intestines, so that, unless there be very marked distention of the thorax, sufficient to displace the liver downward, percussion will be of little value. Thus it is the extent, and not the intensity, of the pulmonary resonance that is to be considered.

Auscultation.—The respiratory murmur is usually feeble and of a low pitch. Expiration is prolonged. When bronchitis is present sonorous, sibilant, and mucous râles are heard. The heart-sounds are generally clear; the second sound may be accentuated in older cases.

Prognosis.—Recovery from compensatory emphysema, if the malady has not existed for too long a time, may be expected. Perfect restoration of the lungs, however, when substantive emphysema has once become established, is not to be looked for. It never of itself proves fatal; still, it may be a complicating factor in bringing about a fatal issue. It is claimed by some that in cases of short duration with but limited involvement of the lung, under favorable circumstances recovery may take place. Not infrequently, improvement, even to the extent of an apparent cure, may be observed, but later in life, in most instances, it will be found to have been only temporary. At one time it was erroneously believed that emphysema protected the subject against tuberculosis.

Treatment.—In children the treatment should be mainly prophylactic. As malnutrition is evidently a predisposing factor, everything pertaining to the

diet and hygiene, even from early infancy, should receive due consideration. In this way the exciting causes of the disease may be prevented, or, should they develop, the patient will be in a better condition to withstand them.

When the affection is present it is infinitely necessary that measures be adopted toward the improvement of the general health. The whole body should be protected by woollen underclothing. The cold sponge bath, used only to an extent that will produce a proper reaction, is a general tonic of unquestionable value. By maintaining a healthful condition of the skin it lessens the liability to repeated bronchial catarrhs. An abundance of out-door air, with exercise regulated to suit the physical endurance of the patient, is an essential part of the treatment. An equably dry climate with an altitude of not over a thousand feet is very desirable. The diet should be principally nitrogenous. The value of milk is too well appreciated to need more than mere mention. The quantity of food taken at one time should not be great enough to cause any embarrassment of the respiration. Cod-liver oil, particularly if rachitis be present, should be administered. When the pure oil is given, begin with small doses, five to ten drops three times a day, and increase gradually until a full teaspoonful is reached. The emulsion of cod-liver oil, either simple or in combination with malt extract, is in some cases preferable to the plain oil.

In the way of medicinal treatment iron in some form should be used when there is any evidence of anæmia. Of the different preparations, the tincture of the pomate is for children one of the most acceptable both to the palate and the stomach. A child three years of age may be given from five to eight drops in a little plain or sweetened water three times a day; at ten years, ten to twenty drops. The citrate or the tincture of the chloride may also be used. In older children either Basham's mixture or the ethereal tincture of the acetate of iron can be recommended.

Strychnine has been thought to possess some specific virtue in the treatment of this disease. That its action is anything more than that of a general tonic seems doubtful. Care should be taken in prescribing the drug for young children. Tincture of nux vomica is a safer preparation, and may be administered in from one-half to two-drop doses at six years of age. Arsenic in the form of Fowler's solution, in from one-half to two-drop doses at eight years of age, is a general tonic of some value.

The mechanical treatment by compressed air, while valuable in certain cases in the adult, is less practicable, and may be positively harmful, in children.

All the exciting causes of compensatory emphysema or those that aggravate the substantive form, if not preventible, should be mitigated as much as possible.

For the chronic bronchitis that so often coexists with substantive emphysema iodide of potassium is generally recognized as a drug of great worth. In many cases favorable results may be obtained by combining it with linseed oil, as follows:

℞. Potassii iodidi . . . . . ʒij.
Ol. lini . . . . . fʒiij.
Pulv. acaciæ . . . . . ʒiij.
Ol. gaultheriæ . . . . . gtt. viij.
Syrupi . . . . . fʒij.
Aq. dest. . . . . q. s. ad fʒvj.—M.
Ft. emulsio.
Sig. Teaspoonful three or four times a day at ten years of age.

Another drug of marked excellence where there is much bronchial secretion is terebene. At eight or ten years of age it may be given thus:

℞. Terebene . . . . . f℥ij.
Tinct. opii camph. . . . . f℥ss.
Ol. menth. pip. . . . . gtt. vj.
Syr. acaciæ . . . . . q. s. ad f℥iij.—M.
Sig. Teaspoonful every four hours.

The treatment of the complicating asthmatic attacks will be considered in the article on Bronchial Asthma.

BRONCHIAL ASTHMA.

By JOHN DORNING, M. D.,

New York.

Asthma is a peculiarly distressing form of paroxysmal dyspnœa, accompanied by wheezing respiration and characterized by a freedom from all manifestations of the affection in the intervals of the attacks.

Etiology.—It seems to be generally conceded by writers on the subject that those who suffer with asthma inherit a tendency to the disease. In many cases there is an ancestral history of gout instead of asthma. According to the statistics of Théry and Hyde Salter, asthma is more common among males than females. It is of frequent occurrence during childhood. Of Hyde Salter's 225 cases, 71 developed the disease during the first decade. It is said to be more common in the upper than in the lower walks of life. In a certain class of cases the cold season seems to exert some predisposing influence on the malady.

The exciting causes may be divided into those which act directly upon the nervous mechanism of the lungs, and those which are reflected from more remote parts or organs.

It is to be borne in mind that the exciting causes are only operative when there is a predisposition to the disease. In some instances no definite exciting cause can be discovered. Uræmic, cardiac, gouty, saturnine, and mercurial asthma are thought to be the result of an irritation of the respiratory centre in the medulla oblongata by vitiated blood. Irritation of the pneumogastric nerve along its course, as by the pressure of enlarged bronchial glands, may give rise to paroxysms of asthma. Eustace Smith has rarely failed to find evidence of swelling of the bronchial glands in the cases he has seen of asthma in the child. The enlargement of these glands is a result of bronchial catarrh. The asthma observed in the subjects of congenital syphilis, the so-called syphilitic asthma, can very likely be explained by a syphilitic enlargement of the bronchial glands. Bronchitis, either alone or associated with emphysema, is generally recognized as an exciting cause of asthma. Such cases may be accounted for either by a direct irritation of the terminal filaments of the pneumogastric nerve or by the concomitant swelling of the bronchial glands.

The inhalation of various irritants, as dust, the pollen of plants, smoke, gases, certain vapors, and the emanations from certain animals, are well known to excite asthmatic attacks. In this connection idiosyncrasy plays a prominent part. Some individuals are susceptible to only a few or perhaps but one of such irritants, and what will excite a paroxysm in one patient will have no influence on another. Thus, one patient cannot bear the perfume of some particular flower, as the rose, Easter lily, or heliotrope; another cannot tolerate the presence of a cat, horse, or dog; and a third dare not

encounter the air of certain localities. It is a well-known fact that a change of residence may either bring on the attacks or entirely prevent them. Sudden changes in the barometrical pressure, with strong easterly or northerly winds, are particularly detrimental to some asthmatics. Indigestion, overloading the stomach, or the ingestion of certain articles of diet not infrequently precipitates a paroxysm. In some rare instances intestinal worms are said to be an exciting factor. Asthmatic attacks may be induced by polypi in the nose. Voltolini of Breslau was the first to direct attention to this fact, and his observations have been confirmed by later investigators. Hypertrophy of the mucous membrane over the turbinated bones and nasal septum has been shown by Daly, Harrison, Roe, Allen, Hack, and others, to be a source of reflex irritation in provoking paroxysms of asthma, more especially hay asthma. Skin eruptions, notably eczema and urticaria, have been included in the category of exciting causes. West has "never known eczema to be very extensive and very long continued without a marked liability to asthma being associated with it." Cases have been observed where asthma and eczema have coexisted or alternated with each other, and the cure of one has been coincident with recovery from the other. It would seem not unreasonable to assume that where urticaria or eczema and asthma coexist or alternate with each other, instead of there existing a reciprocally etiological relation between the two, both are dependent upon some common cause.

Pathology.—Thus far, no well-defined post-mortem alterations have been discovered that would place the pathology of bronchial asthma, if it really be a distinct affection and not merely a symptom, without the domain of speculation. There is a number of theories regarding the nature of this affection, the most plausible of which are:

1st. That it is due to spasm of the bronchial muscles—the most popular theory at the present time. This theory is based upon the experiments of Williams and Longet, who, after the discovery of muscular tissue in the walls of the finer bronchi by Reisseisen, found that electrical irritation of the lungs and pneumogastric nerve produced contraction of the bronchial tubes. Among the advocates of this theory are Romberg, Bergson, Trousseau, Hyde Salter, Paul Bert, and Biermer.

2d. The next theory, and one having many supporters, is that the dyspnœa is due to a sudden tumefaction of the bronchial mucous membrane with exudation, the result of turgescence of its blood-vessels caused by the action of the vaso-motor nerves (Weber), fluctionary hyperæmia (Traube). Stoerck adopted this theory from having, during the paroxysm, observed with the laryngoscopic mirror an acute hyperæmia of the laryngeal and tracheal mucous membrane, which disappeared after the attack had subsided, and he consequently inferred that the same condition existed in the smaller bronchial tubes.

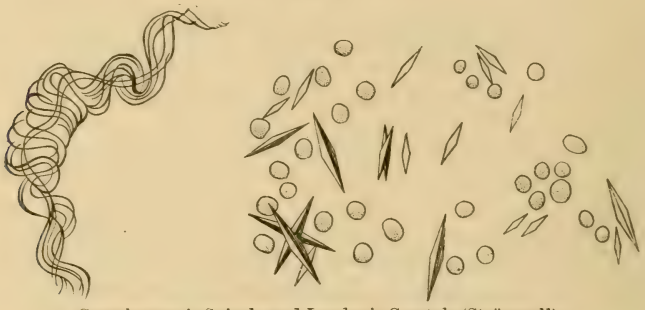
3d. Another view regarding the nature of this malady is that it is dependent upon a catarrh of the bronchioles (bronchiolitis exudativa). This theory is based on the presence in the sputum of certain peculiar spiral structures described by Curschmann (Fig. 1).

Leyden discovered in the sputum of asthmatics certain elongated octahedral crystals (Fig. 1), which he believed, by their irritation of the terminal nerve-filaments in the bronchial mucous membrane, induced bronchial spasm. These crystals have been found in pneumonic expectoration, and hence, while not pathognomonic, they may be of some diagnostic value in differentiating bronchial asthma from other forms of dyspnœa.

Symptoms.—In the majority of instances the asthmatic attack occurs without any premonition whatever; sometimes, however, certain sensations are

experienced which to those who have previously suffered are pretty sure evidence of an approaching paroxysm. The premonitory symptom may be a depression or exaltation of spirits, a chilly feeling, a sense of constriction of the chest or throat, flatulent distention of the abdomen, itching of the skin,

Fig. 1.



Curschmann's Spirals and Leyden's Crystals (Strümpell).

the voiding of a large quantity of clear urine, or some other functional disturbance peculiar to the individual. Not infrequently an acute catarrh of the upper air-tract precedes the attack.

The paroxysm generally comes on after the patient has retired for the night; still, it may occur at any hour of the day. It commences with the characteristic wheezing, and soon the patient is awakened by a distressing sense of lack of breath, which becomes more and more urgent until he is finally compelled to assume a position that will facilitate an easier entrance of air into his lungs. He may sit up in his bed or in his chair, with his hands grasping his knees, his shoulders elevated, and his head thrown backward, so that all the muscles of respiration and their auxiliaries may act to greatest advantage; or, he may find greatest relief by kneeling before his cot or chair with his head resting on his hands or a pillow. Often the desire for breath is so pressing that the sufferer will rush to an open window in the hope of obtaining relief. The face assumes an anxious expression, pallid at first, and as the dyspnœa increases changing to a dusky bluish hue. The eyes are prominent and have a staring expression, the nostrils are widely dilated, and the mouth is partly open. The skin becomes moistened with perspiration as the distress increases. The respiration, particularly expiration, is noisy and wheezing, and may be heard in the adjoining apartment. Inspiration is short and jerky, expiration very much prolonged. The number of respirations is seldom much increased, and may be even less than normal. Speech, beyond monosyllables, is impossible. Notwithstanding the laborious efforts in breathing there is merely an up-and-down movement of the ribs, with but little or no expansion, the thorax being fixed in the position of full inspiration. The pulse is small, rapid, and thready in proportion to the intensity of the dyspnœa. There is no elevation of the temperature. If the attack be prolonged, the surface temperature falls below normal, the extremities become cold, clammy, and bluish, and death seems imminent.

As the paroxysm subsides there is more or less cough and expectoration, whether they have previously existed or not. In some cases the expectoration consists of rounded masses of tenacious mucus; in others it is profuse and watery. Sometimes streaks of blood are found. In some rare and severe cases hæmoptysis has been known to occur.

After the paroxysm there is usually considerable exhaustion, and the patient soon falls asleep. On awakening, with the exception of a little soreness of the respiratory muscles, no discomfort is experienced, and the patient afterward enjoys his usual health.

The duration of the attack may vary from a few hours to several days, with remissions and exacerbations. The paroxysms vary in frequency. They may recur as often as once a week or there may be an interval of months between them. Ordinarily there is no regularity in the recurrence of the attacks. A periodicity, however, is sometimes noticed, and is probably due to some condition operative only at particular times.

PHYSICAL SIGNS.—During the paroxysm inspection shows an expanded and barrel-shaped thorax, with but little respiratory motion. Inspiration is short and quick, expiration prolonged and violent. On percussion more or less hyper-resonance is obtained: in mild cases it is slight, but when the attack is severe and of long duration it is usually quite marked. Auscultation reveals, in severe cases, diminution or suppression of the vesicular murmur.

In mild attacks the respiratory murmur may be exaggerated and jerky. All over the chest may be heard an ever-changing variety of sonorous and sibilant râles. They are piping, cooing, wheezing, and often musical in their nature. They are louder during expiration. Toward the close of the paroxysm moist râles are to be heard, or, if bronchial catarrh exists, they may be detected from the beginning of the attack.

Prognosis.—Uncomplicated asthma is, *per se*, rarely if ever fatal. In general the prognosis is better in young subjects than in adults. Hyde Salter makes the statement that "in young asthmatics the tendency is almost invariably toward recovery." The prognosis may be said to be favorable when the attacks are dependent upon some removable cause, when mild and occurring at long intervals, when there is no hereditary predisposition, and when there is freedom from complications.

Diagnosis.—The rational and physical signs of an uncomplicated paroxysm of asthma are so distinctive that, if properly appreciated, there should be little or no difficulty in reaching a correct diagnosis.

The affections which it is thought may possibly be mistaken for bronchial asthma are the various forms of obstruction in the upper air-passages, as foreign bodies in the throat; retro-pharyngeal abscess; diphtheritic and false croup; œdema of the glottis: neoplasms of the larynx; spasmodic contraction of the adductors of the larynx or paralysis of the abductors; tracheal stenosis or foreign body in one or the other of the main bronchi; bronchitis, pneumonia; emphysema; pulmonary œdema: pleuritic effusion; cardiac disease; uræmia, and spasm of the diaphragm.

In obstructive dyspnœa from any cause the difficulty in breathing is during inspiration, while in asthma it is during expiration. There is also inspiratory recession at the episternal notch and epigastrium not observed in asthma. In the former there is the absence of wheezing in the chest, and the dyspnœa is continuous instead of paroxysmal, as in asthma. Changes in the quality of the voice will exclude the latter affection. Examination of the throat with the finger or mirror will enable one to determine the exact nature of the obstruction. Occlusion of a main bronchus will cause a diminished intensity or absence of the respiratory murmur on the affected side. The dyspnœa of bronchitis and pneumonia comes on gradually and is attended with some degree of fever; the respirations, particularly in pneumonia, are rapid and often short and catching. In asthma the onset is

more sudden, there is no elevation of temperature, and the respirations are either but slightly or not at all increased in frequency.

Some difficulty may be experienced in distinguishing between emphysema and asthma on account of their frequent coexistence. Each may induce the other. Emphysema more often exists without asthma than does the latter affection without some degree of the former. In emphysema the dyspnœa is remittent rather than intermittent as in asthma. It is aggravated by physical excitement, and hence is more likely to occur during the day than at night. In pulmonary œdema the increased frequency of the respiration, with perhaps some dulness on percussion, the presence of large and small moist râles all over the chest, the profuse and watery expectoration, and the absence of wheezing will ordinarily distinguish it from asthma. In pleuritic effusion the usual dulness on percussion, the limitation of the diminished respiratory murmur to the area occupied by the fluid, the detection of ægophony, and the absence of the characteristic dry râles of asthma will suffice for a diagnosis.

Cardiac asthma is not very common in children. It, however, resembles bronchial asthma in that it may be paroxysmal in nature, intense in degree, and may come on at night. It generally follows cardiac excitement. The absence of the varied musical sounds in the chest and of the prolonged expiration, and the presence of a cardiac lesion capable of inducing dyspnœa, will be of some assistance in distinguishing the one from the other.

Dyspnœa due to uræmia need never be confounded with bronchial asthma if the precaution is taken to examine the urine of every case coming under observation.

Spasm of the diaphragm may be distinguished from asthma by the sudden, abrupt inspiration, the hiccough, and, after a few seconds, the quick, violent expiratory effort.

Treatment.—The treatment of asthma comprises the management of the paroxysm and the treatment of the patient in the intervals between the attacks. If possible, the exciting cause should be discovered and removed. For instance, if clearly dependent upon an overloaded stomach or the presence of some indigestible substance in the alimentary canal, an emetic or an enema will afford prompt relief. To relieve the patient during the attack, in the absence of any apparent and removable cause, it generally becomes necessary to have recourse to some sedative or depressant. The numerous drugs recommended vary so in their action upon different subjects that not infrequently a number have to be tried before the one is found that gives the greatest relief. The one drug that is most frequently successful in cutting short the paroxysm is morphine administered subcutaneously. In young children, however, it is rarely necessary to use it, as some one of the remedies to be mentioned will usually be found to be sufficiently effective. In later childhood, if given, the greatest caution should be observed, as children are markedly susceptible to the toxic influence of morphine. To a child ten years of age from $\frac{1}{18}$ to $\frac{1}{12}$ of a grain of the sulphate, combined with $\frac{1}{250}$ of a grain of atropine sulphate, may be given hypodermatically. Next to morphine in abating the asthmatic paroxysm comes chloroform. The relief is speedy, but often only temporary, so that repeated inhalations are usually required. In the writer's experience chloral hydrate is superior to chloroform at any period of childhood, in that its effects, though less prompt, are more lasting. At five years of age 5 grains dissolved in at least 1 drachm of some simple menstruum, may be given, and repeated in forty minutes if there be no abatement of the dyspnœa. If it cannot be taken by the mouth, 10 to 15 grains dissolved in half an ounce of water may be injected into the rectum.

The fumes of nitre-paper (charta potassii nitratis), a very popular remedy, will often cut short a mild attack and give considerable relief in a severe one; sometimes it has no effect at all. The remedy is prepared by dipping a sheet of absorbent paper into a saturated solution of nitrate of potassium and afterward drying it: the dried paper is then cut into pieces of the required size and is ready for burning. The patient should be placed in a small room or in some kind of an extemporized tent, so that he can inhale the fumes of the burning paper. It acts promptly if at all, at first exciting some cough, but in a few minutes alleviating the distress.

Inhalation of the smoke of Datura stramonium and Datura tatula is often serviceable. In young subjects it must be used with care, and the inhalation stopped as soon as the sight or intellect becomes confused. Lobelia and belladonna, either separately or combined, are beneficial in some cases.

Tobacco, while an excellent remedy in adult cases, is too powerful a depressant to be recommended in children. The nitrite of amyl and nitro-glycerin do good, but they have not yielded such results as would be expected from our knowledge of their physiological action. If used at all in children, they must be given with due caution. Quebracho and Grindelia robusta have been advocated, but their action is uncertain.

Iodide of ethyl is thought to be efficacious (Germain Sée). Eight to twelve drops by inhalation is a fair dose at eight years. Pilocarpine, $\frac{1}{8}$ to $\frac{1}{10}$ of a grain hypodermatically at five years, has been advocated by Berkart. Coffee and alcohol are useful in the adult; but it is questionable if it would be wise to have recourse to them, particularly the latter, in children.

Intense mental emotion, as a sudden alarm or a pleasurable surprise, will frequently at once check an asthmatic paroxysm.

During the intervals of the attacks every effort should be made to discover and remove the exciting cause. Hypertrophied turbinated bodies should be reduced, nasal polypi extirpated, adenoid growths in the naso-pharynx removed, and catarrh of any part of the respiratory tract relieved by appropriate measures. Particular attention should be given to the diet, especially when the asthmatic attacks bear any relation to the state of the digestion. As a rule, it is best to allow only a light and easily-digested supper, and that early enough in the evening to be digested and passed from the stomach before retiring.

When there is no apparent exciting cause the general condition of the patient requires attention. The value of an out-door life, in the open country if possible, the daily cold sponge-bath, the protection of the body by suitable clothing, and a nutritious diet in the asthmatic subject is too well appreciated to require more than mere mention. All those affections that directly or indirectly cause enlargement of the bronchial glands are to be most sedulously guarded against. Cod-liver oil, beginning with small doses and gradually increasing, should be administered in most cases. Iron is frequently indicated. The tincture of the pomate of iron in from 5- to 10-drop doses at five years of age is an acceptable and easily-digested preparation for children. The tincture of the chloride or the syrup of the iodide may be given if the digestion be good. In many cases arsenic renders good service. It is best administered in the form of liquor potassii arsenitis (Fowler's solution), beginning at the age of five years with 1 drop in water three times a day, and increasing gradually to 4 or 6 drops. On the supervention of toxic symptoms the drug should be discontinued for a time.

Iodide of potassium is lauded as possessing some special beneficial action in asthma. If given to the point of tolerance and continued for a long period of time, it often yields good results. In some cases, however, it utterly fails.

Quinine and strychnine have their respective advocates. The former will prove valuable where there is a malarial complication. In small doses they are both tonics.

Change of climate or locality will relieve some patients. Asthma is such a capricious malady that it would be next to impossible to select any particular locality and guarantee immunity from the attacks. Some city patients are benefited by removal to the country, those living in the country by going to the city, dwellers at the sea-coast by a change to the interior, and those living inland by a residence at the sea-board. The fact of the matter is, each patient must select his own climate.

FIBROID PHTHISIS.

By FREDERICK C. SHATTUCK, M. D.,

Boston.

This affection—otherwise known as chronic pneumonia, interstitial pneumonia, cirrhosis of the lung, or fibroid induration of the lung—is a process not uniform in origin, generally unilateral, very chronic in course, resulting in the substitution of connective for pulmonary tissue in a more or less considerable area, usually associated with bronchial dilatation, and often, at some period in the case, with tuberculosis.

Etiology.—This condition—for, in the great majority of cases at least, it is a condition rather than a disease—is not very common at the best, and is, in its fully-developed form, very rare in children, though its origin may date back to childhood. Of 30 fatal cases with autopsy collected by Bastian in Reynolds's *System of Medicine*, only 2 were under fifteen years of age, 3 from fifteen to twenty, while more than one-half of the cases succumbed between twenty and forty. The age of both children was seven years, and one of them was reported by Sir D. Corrigan in his original paper on "Cirrhosis of the Lung," published in 1838 in the *Dublin Journal*. In Wilson Fox's great posthumous work on "Diseases of the Lung and Pleura" will be found references to other cases in children.

That the affection should be rare in children is not surprising, inasmuch as inflammation, like nutrition, in the young is a more active process than in adults, and is less likely to lead to the formation of organizable products than in later life. The power of complete repair is also greater in children, and in them, if recovery takes place, it is less likely to leave permanent or progressive changes behind. The literature of the subject would seem to show that in children pneumonia and broncho-pneumonia are the affections which are most apt to be followed by fibroid changes in the lung. Of the two, the latter is probably the more frequent antecedent. That simple bronchitis may pave the way to connective-tissue growth seems probable. It is certain that pleurisy may do so, though this origin is probably more frequent in adults. The thick false membranes may then serve as the starting-point for a growth of connective tissue into the contracted lung itself, while bronchiectasis gradually comes about as a result of frequent cough, and also as a means of equalization of the atmospheric pressure within and without the chest. Other things being equal, the older the person the more rigid the chest-wall and the less can it collapse. The space which the firm adhesions prevent the lung from reoccupying must thus be filled in a measure by dilatation of the bronchi, of some of the air-vesicles, and even of the blood-vessels and lymphatics.

There is another sequence of events which is certainly more common in adults, if indeed it ever occurs in children. The arrest of an ordinary ulcerating pulmonary tuberculosis, with the formation of abundant connective-tissue growth in which the bacilli are, as it were, bottled up, is here alluded to. The writer has seen some conspicuous examples of this. The report of one of them,

with autopsy, may be found in the *Boston Medical and Surgical Journal*, 1880.

The fibroid phthisis which results from irritation by particles of dust, as in miners, grinders, painters, and the like, is not apt to be encountered in children, and is a bilateral affection.

The view is expressed by Strümpell, Osler, and other recent writers that most cases of fibroid phthisis either are or have been tuberculous. That this is true of some cases there can be no question; but further investigation is needed to enable us to determine how large the proportion is, or whether, indeed, such destructive processes ever go on without the aid of the tubercular bacillus. That many of the inflammations of serous membranes, including the pleura, formerly believed to be simple or due to exposure to cold, are really tubercular, seems now to be well established. And the origin of some of these cases of fibroid phthisis in pleurisy has been already alluded to. The discovery of the true criterion of tuberculosis is still too recent to permit the accumulation of sufficient positive evidence to establish the relation of fibroid phthisis and pulmonary tuberculosis. In the older reports, if no miliary tubercles or caseous masses were found after careful search, the case was classed as non-tubercular. I have not met with any reports of thorough microscopic examination of these cases of late years. But we have learned since Koch's great discovery more than we knew before as to the multiplicity of the lesions following the local and general action of his bacillus, and also more as to their frequent self-limitation, and, indeed, curability.

Pathological Anatomy.—The striking morbid feature of this affection is the presence of connective tissue in the lung with corresponding destruction of the true parenchyma. The changes are generally unilateral, and may be so even when the primary process—broncho-pneumonia, for instance—is essentially bilateral. The lower are more frequently affected than the upper lobes. Bands of fibrous tissue may traverse the affected part, and these bands are, for obvious reasons, less likely to be pigmented in the young than in adults. Or the distribution of the connective tissue may be more uniform, producing an appearance which has been compared to that of the uterus after delivery. Peribronchitic thickening is practically always present to a greater or less degree, as is also bronchial dilatation, resulting in the formation of cavities of greater or less size.

Another mode in which cavities are formed or increased in size is through ulceration, the accompaniment of the growth of tubercular bacilli or the result of the irritation of retained and decomposing secretion, or both at once. Miliary tubercles, caseous masses, or calcified deposits may be seen by the naked eye. The microscope may reveal tubercular bacilli in active growth in the secretion or the tissues, or safely imprisoned within the connective tissue. Here and there within the diseased portions there may be macroscopic or microscopic islets of relatively normal or of emphysematous lung-tissue. The microscope may also demonstrate within the indurated lung or the thickened pleura dilated blood- and lymphatic-vessels.

The affected lung may be moderately or very greatly diminished in size, with corresponding contraction of the chest, approximation of the ribs, droop of the shoulder, and twist of the vertebral column.

The pleura is rarely if ever spared; it may contain an encapsulated collection of fluid, more probably sero-fibrinous. Adhesions vary considerably in thickness and density; they may be cartilaginous, and so firm that the lung must be cut out of the chest at the autopsy. It seems reasonable to suppose that when the process started in the pleura the thickening of that membrane is more con-

spicuous than when it started in the lung itself and secondarily affected the pleura, as does every inflammatory process of the lung or of the chest-wall which approaches one or the other layer of the serous cavity.

The sound lung, or sound portions of both, is the seat of compensatory hypertrophy; perhaps of emphysema, either confined to the edge or more widely distributed. Adhesive pericarditis is common as a result of extension of inflammation from the pleura, especially when the left lower lobe is the seat of the disease. The heart itself is often more or less drawn out of place, and the right chambers are apt to be dilated and hypertrophied in extensive disease of long standing, in consequence of the augmented internal pressure to which the cavities are subjected by reason of the increased resistance in the pulmonary circulation. If compensation has failed in the right ventricle, the common secondary results of such failure are shown by general and visceral venous stasis.

Symptoms and Course.—Cough and expectoration are practically constant, though they vary widely in degree and severity in different cases or in the same case at different times. The character of the expectoration is not distinctive. If notable cavities of bronchiectatic or other origin are present, their existence may be suggested by a more or less periodically profuse expectoration, by profuse expectoration in certain positions of the body, or by the separation of the sputum on standing into an upper frothy, a middle serous, and a lower layer of purulent masses. The presence of tubercle bacilli is suggestive of a recent infection from without or of a fresh outbreak from within. If ulceration is going on, elastic fibres may be found. Hæmoptysis is extremely common, is often repeated, and usually moderate in amount. It may, however, as in ordinary phthisis, arise from a good-sized vessel traversing the wall of a cavity, and then be so profuse as to be the immediate cause of death. Dyspnœa may be absent while the patient is at rest, but very marked after but slight exertion.

Constant fever, with its attendant emaciation and constitutional disturbance, is absent. The process in itself is not a febrile one, and a rise of temperature which may be found at any time is attributable to some secondary or complicating affection. General nutrition may be excellent, and the fat layer notable. Clubbing of the tips of the fingers and toes and incurvation of the nails may be more marked in this than in any other condition, save, perhaps, congenital heart defects; this is an infallible indication of chronicity. In a word, the appearance of the patient may be, in the main, that of one in perfect health, from which a wide deviation is found to exist when the clothing is removed from the chest and a physical examination is made.

It does not seem advisable under the circumstances to enter here into a detailed account of the physical signs, which are so similar to those of a case of chronic tuberculosis. I shall therefore briefly touch only on those which are most striking and distinctive.

Inspection is apt to show a disparity in size and mobility between the sides of the chest; unilateral shrinkage, the droop of a shoulder, and curvature of the spine reaching their highest expression in those cases originating in or complicated by extensive pleural changes. Palpation, auscultation, and percussion reveal the presence of consolidated lung containing secretion, perhaps of cavity formation. As contrasted with ordinary phthisis, these changes are more apt to be found at the base than at the apex. Cardiac pulsation may be visible over unusually large or in unwonted areas, according as retraction of the lung away from the heart, or adhesions to the pericardium and retraction of the heart itself, or both together, may happen to have operated in the case in

hand. Sometimes, however, the heart is unduly overlapped by the hypertrophied healthy lung, and its pulsations may then be obscured. Although the right heart is apt to be, often markedly, hypertrophied and dilated, the fact that it is so must be often a matter rather of inference than of direct signs furnished by the examination of the organ itself. The explanation of this fact lies in the altered mutual relations of the lungs and heart under the influence of the disturbing factors mentioned above. Cardiac murmurs bear no constant relation to the condition.

If, for any cause, the compensatory hypertrophy of the right ventricle fails, the characteristic evidences of stasis in the pulmonary and systemic veins are superadded to those of the underlying condition—cyanosis, distention or pulsation of the jugulars, anasarca, ascites, enlarged or tender liver, the urine of passive renal congestion, and the like.

The course of the affection is essentially chronic, and, on the whole, progressive, though apparently stationary periods, perhaps of considerable duration, seem to occur. Intercurrent attacks of bronchitis are not rare, and certainly do nothing to retard progress. Death may occur from failure of the cardiac compensation, hæmoptysis, exhaustion, or from intercurrent disease.

Diagnosis.—This can seldom present any great difficulties, provided that a good history can be obtained and a careful physical examination be made. The combination of a history of chronic cough and expectoration, with repeated hæmoptysis; the physical signs of pronounced lung destruction, usually unilateral, often with cavity-formation; and hypertrophied and dilated right ventricle, with the maintenance of a surprisingly good condition of general nutrition, presents a picture which is perfectly characteristic. The very small respiratory margin is also noteworthy. Chronic pleurisy with great thickening of the membrane and contraction of the side is perhaps more liable to give rise to error than any other affection. The history of the case, but, above all, the signs of pronounced pulmonary changes, and the occurrence of hæmoptysis, are the chief aids in the differentiation. The good general nutrition, the absence of fever, and the duration and mode of onset of the trouble are sufficient to exclude ordinary pulmonary tuberculosis. The thoracic physical signs of cancer of the lung or pleura might be similar; but the course and duration are quite different. Congenital syphilis of the lung is of pathological rather than clinical interest. Acquired syphilis of the lung is very rare in children: it is also rare in adults, but resembles clinically ordinary phthisis more than the fibroid variety, which, moreover, is not amenable to mercury and the iodides.

Prognosis.—There can be no question that the expectation of life is curtailed by this condition. Probably Dr. Oliver Wendell Holmes did not have it in mind when he said that the way to ensure length of days is to acquire an incurable disease. And yet its owners may live many, many years. The danger is rather from intercurrent disease than from the fibroid induration of the lung itself. If the patient's circumstances permit, he will naturally lead a more careful life than if he were sound in all parts. In a case of the writer's, proving fatal at twenty-eight years of age, the onset dated back presumably to measles at the age of seven, and yet the patient worked as a shoeblack in a damp, narrow, and sunless alley in all sorts of weather until shortly before his death from hæmoptysis. Had he been able to take care of himself, it is probable that he might have lived many years longer.

Treatment.—It is obvious enough that little can be done to repair damage already done. Therapeutic effects must, therefore, in the main, be directed to staying the progress of the affection as far as possible, and to warding off intercurrent diseases, which may either promote the extension of the

fibroid growth or carry off the patient. Hygienic measures are thus vastly more important than medicinal agents. The limitation of the respiratory capacity is such in most cases as to preclude residence in high altitudes. Climatic change has for its object an abundant supply of fresh, pure air with lessened risks of colds and bronchitis. The amount and character of exercise are to be determined by the peculiarities of each case. Tonics and stimulants are to be given if the appetite and digestion seem to require them. Expectorants may be needed from time to time. Narcotics and hypnotics, except occasionally and in the last stages, are to be avoided as far as is possible. Iodide of potassium may render good service in promoting recovery from bronchitis, but cannot be expected to have much influence on the connective tissue growth. Failure of compensatory hypertrophy of the right heart calls for cardiac tonics, as when it occurs under other circumstances.

In a word, it should be our aim to keep our patient in the highest possible condition of health, treating him rather than his disease.

PART IX.

DISEASES OF THE HEART.

CONGENITAL AFFECTIONS OF THE HEART.

By BARTON COOKE HIRST, M.D.,

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Cardiac anomalies of pre-natal origin, like other developmental abnormalities, cannot be easily classified in a thoroughly satisfactory manner. Osler gives an etiological division into (1) those affections due to defective development, (2) those resulting from intra-uterine endocarditis; and (3) those that are caused by a combination of both causes. The same author employs, however, the following general classification: I. Conditions in which structures normal to the fœtus persist during extra-uterine life, such as open foramen ovale, persistency of the Eustachian valve, and patency of the ductus arteriosus. II. True anomalies of development, as absence or imperfection of the ventricular septum, absence of the auricular septum, anomalous division of the truncus arteriosus, transposition of the great vessels, and numerical variations in the valve segments. III. Conditions caused wholly or in part by endocarditis, as extreme stenosis of the cardiac orifices, puckering, thickening, and adhesion of the valve segments.

The writer will employ Baginsky's classification, somewhat modified, as follows:

1. Patency of the foramen ovale.
2. Defect of the ventricular septum.
3. Anomalies of the right and left auriculo-ventricular orifices.
4. Stenosis and atresia of the pulmonary artery.
5. Persistence of the ductus arteriosus.
6. Stenosis of the aorta.
7. Transposition of the arterial trunks.
8. Numerical anomalies of the valve segments.
9. Ectopia cordis.

1. Patency of the Foramen Ovale.—Much attention—more than it deserves—has been bestowed upon this affection of the heart. Of itself, it does not entail, as a rule, any disadvantage upon the individual. A patent foramen ovale has been discovered in many persons dying of a variety of diseases, in whom, during life, there was no evidence of heart embarrassment. Unless there be associated anomalies, congenital or acquired, increasing the pressure in the right auricle, the blood will not flow in any quantity from right to left auricle, even though the foramen be open, and consequently the arterial blood

will not be vitiated to any appreciable extent. If pressure be increased in the right auricle by a contracted auriculo-ventricular septum or by an obstacle to the escape of blood from the right ventricle, then the stream may be deflected into an abnormal course, the heart be embarrassed by extra work, and the blood in the aorta become mixed. The child will be cyanotic, and its life will very likely be cut short.

If the size of the patent foramen is increased by a defect in the anterior muscular septum between the auricles, as well as in the membranous septum, the anomaly is a very serious one. I have had an opportunity to make a post-mortem examination in two such cases. In both the children lived but a few hours after birth, and they were intensely blue. In one the cyanosis reached a grade I have never witnessed before or since.

The cause of a patent foramen ovale is either an absence or defective development of the membrana fossæ ovalis or a defective institution of respiration. Normally, the opening is closed by the increased blood-supply to the auricles incident to the beginning of respiration. Should the latter act be imperfectly performed, as in atelectasis, the mechanical force to close the foramen by pressure upon its valve—with the subsequent adhesion of its free edges to the rim of the oval fossa—is lacking. More frequently, however, in infants that survive birth the membrana fossæ ovalis is lacking or ill developed, and the foramen consequently cannot be closed. It is claimed by Sansom that patency of the foramen can be diagnosticated during life by cyanosis without heart murmur, or by cyanosis with systolic and presystolic murmurs over the cartilages of the third and fourth ribs. But if one remembers that there are many other causes of cyanosis in the new-born infant besides heart defects, and that an open foramen uncomplicated by other anomalies may very likely present no symptoms at all, the difficulty of making this diagnosis may be appreciated. As interesting anatomical conditions under this head, but without clinical significance, are to be noted perforations of the valve of the foramen ovale and small slit-like openings under the valve where it has not adhered to the rim of the opening. The last are very common.

2. Defect of the Ventricular Septum.—This anomaly is most frequently associated with other abnormalities of the heart, as stenosed orifices and vessels, or defect of the auricular septum. It is not at all uncommon in its lesser degrees, but total defect is rare, and, when present, is associated almost always with defect of the auricular septum, constituting the so-called reptilian heart or cor biloculare. The defect is most frequently found in the anterior muscular portion of the septum, as shown by Rokitansky, and not in the median membranous portion, where it formerly was believed to be most frequently situated, but is in reality very rarely found. The effect of an unnatural opening between the ventricles is a propulsion of some of the blood from the left ventricle into the right during the former's contraction. Should the latter sufficiently hypertrophy to dispose of the extra amount of blood thrown into it, there need not necessarily be striking symptoms of heart defect. But should the hypertrophy not be sufficient, there results an embarrassed respiration and an obstructed venous circulation, with cyanosis and transudation of serum into connective tissue and body-cavities. As Baginsky points out, the cyanosis is due to this cause, and not to the mixing of arterial and venous blood.

The diagnosis of defect in the ventricular septum can be made, it is asserted by Roger and Sansom, by a loud systolic murmur over the præcordial region and between the shoulders, not transmitted to the vessels. The existence of a ventricular septum defect is unfavorable to the life of the infant, mainly on account of the associated anomalies. Sansom, however, records a case in a

child that lived eight and a half years, and Johnstone another that lived seven years.

3. Anomalies of the Right and Left Auriculo-ventricular Orifices.—These consist in stenosis and valve defects, mainly, the result of an intra-uterine endocarditis of the right and left heart-cavities. Osler claims that the endocarditis is secondary to developmental anomalies and is almost always of the chronic, sclerotic type, and very rarely of the verrucose or warty variety. He describes a typical specimen as presenting thickened valve segments, which are shrunken and smooth. In the case of the auriculo-ventricular valves the cusps become united and the attached chordæ tendineæ are thickened and shortened. In the semilunar valves all trace of the segments usually disappears, leaving a stiff, membranous diaphragm perforated by an oval or rounded orifice.

Valve defects from endocarditis are more commonly found upon the right than upon the left side. We shall first, therefore, glance at the anomalies of the right auriculo-ventricular orifice.

There is usually a thickening of the tricuspid valve as well as of other portions of the endocardium. The right ventricle is small. If the disease leads, as is not very uncommon, to complete atresia of the orifice, the circulation is only possible in a roundabout way, and then only when there is a defect in the ventricular septum. The blood flows from the right to left auricle, and from the left ventricle, in part, into the right, and so into the pulmonary artery. The left ventricle, from the additional work thrown upon it, is dilated and hypertrophied. In case of associated stenosis and insufficiency the right heart is dilated and hypertrophied. Cardiac murmurs, systolic and diastolic, with a thrill imparted to the thoracic wall, are loud and distinct, the heart's action is labored, the cyanosis is marked, and passive congestion everywhere is pronounced, leading on slight provocation to hæmorrhages.

In addition to the abnormalities resulting from disease in the tricuspid valves, developmental anomalies may be found, as an imperfect separation of the cusps, so that there is a circular opening between auricle and ventricle, with an annular diaphragm surrounding it. On the other hand, there may be four cusps instead of three.

The most common cause of abnormality in the left auriculo-ventricular orifice is a left-sided endocarditis. If stenosis of the orifice is well marked, the blood in the distended left auricle flows back through the patent foramen ovale into the right auricle, thence into the right ventricle, and so, by the ductus arteriosus, into the aorta. The left ventricle, becoming functionally more or less useless, undergoes atrophy, sometimes to a very marked degree. When the child is born the determination of blood to the lungs, and the increased amount flowing to the left auricle, embarrass the heart extremely. Congestion of the lungs, extreme cyanosis, and an early death is the result. As in the right orifice, there may be the developmental anomalies of imperfect differentiation of the cusps or their division into three instead of two segments.

4. Stenosis and Atresia of the Pulmonary Artery.—Osler divides the anomalies of the pulmonary orifice into stenosis, atresia of the orifice and of the artery, and stenosis of the conus arteriosus.

Stenosis of the pulmonary artery is one of the commonest and most important congenital defects of the heart. A child may live some length of time—may, in fact, reach adult life—with a serious narrowing of the pulmonary orifice and with enormously dilated and hypertrophied heart-cavities and muscles, without special symptoms until some extra strain is imposed upon the heart, especially by congestion of the lungs, when sudden death is likely to

occur. On the other hand, intense cyanosis and embarrassed respiration and circulation may be manifested from the first, and the infant may live but a few hours. The continued existence and development of the infant depend upon the hypertrophy of the heart. If this be truly compensatory, the child may thrive surprisingly well, even in grave cases. The prognosis as regards duration of life is better than in any other form of congenital heart defect of serious character. One individual reached the age of fifty-seven, and 16 per cent., according to Assmus, survive the twentieth year. But the tenure of life is always uncertain, for any sudden call upon the heart for extra work may prove fatal. And these cases are particularly liable to have grafted on them, at some time after birth, a fungous or infectious endocarditis that may be the immediate cause of death. Moreover, individuals affected with a contracted pulmonary orifice are peculiarly liable to tuberculous disease.

The cause of this anomaly is almost invariably an intra-uterine endocarditis, but it may possibly be a developmental defect. The symptoms are cyanosis, with signs of embarrassed circulation and respiration. The body warmth is likely to be very imperfectly preserved. The slightest exposure of the extremities leads to a remarkable frigidity, and the infant manifests signs of discomfort or suffering in consequence, unless it is too apathetic to take note of its surroundings. A mental and physical apathy very likely characterizes the individual throughout life.

As already stated there may be no special symptoms, even in bad cases, or at most, attacks of dyspnœa, lividity and heart palpitation from time to time.

On auscultation a loud systolic murmur is heard over the second and third ribs to the left of the sternum, and at the apex, which is not transmitted to the carotids. A thrill is imparted to the thoracic wall, the area of cardiac dulness is much increased, and the anterior wall of the thorax is protruded in later life.

Complete atresia of the pulmonary orifice and of the artery, while rarer than stenosis, is not very uncommon. The condition is due to defective development, and not to disease. If the atresia is of early appearance in embryonal life, there is a wide opening between the auricles and advanced atrophy of the right ventricle. The blood flows from the right auricle to the left auricle, and in part to the lungs by the medium of the ductus arteriosus. If, as is likely, there is a defect in the ventricular septum, the aorta may arise equally from both ventricles, or even belong more to the right; in which case the latter is much hypertrophied and dilated. The symptoms are more pronounced and the prognosis much worse than in stenosis. There is intense cyanosis, great dyspnœa, the child becomes very often convulsed, and dies usually in a few hours.

Stenosis of the conus arteriosus forms, according to Assmus and Osler, a considerable portion of the cases of obstruction at the pulmonary orifice. The former collected 47 cases of the kind. The condition is due to faulty development. By a constriction of the lower portion and dilatation above, a sort of accessory auricle may be formed. There are almost always other defects of development, as a defective ventricular septum. The symptoms are those of stenosis of the pulmonary orifice.

5. Persistence of the Ductus Arteriosus.—By the fourteenth day, or within the first four weeks at least, the ductus arteriosus is closed by an overgrowth of the cells in its inner wall. Occasionally, in consequence of puerperal infection of the new-born with infected thrombi, or on account of defects in cardiac development, or as a result of the imperfect institution of respiration and an anomalous pulmonary circulation, the duct remains patent. It has been my experience, in making post-mortem investigations upon the

bodies of young infants, that a slight degree of patency is by no means uncommon during the first year of life. It is frequently easy to pass a small probe through the duct or to squeeze a drop or two of blood through, but in such cases the duct, of course, plays no part of practical importance in conveying the main-stream of the blood. The clinical symptoms of an efficient patency of the ductus arteriosus are rapid hypertrophy and dilatation of the right ventricle, dilatation of the pulmonary artery, increase in area of cardiac dulness, long-continued systolic murmurs, thrill of the anterior chest-wall, protrusion of the upper part of the sternum, attacks of dyspnœa, cyanosis or, perhaps, an almost cadaveric hue, a disposition to bronchitis and congestion of the lungs, and anasarca. Atheromatous processes in the pulmonary artery are common in individuals who live some years.

The prognosis is not favorable. Of sixteen cases 7 died in childhood, 5 lived from nineteen to thirty-four years, and 4 to between forty and fifty.

6. Stenosis of the Aorta.—Obstruction at the aortic orifice is the result of developmental defect or of endocarditis, as in the case of obstruction at the pulmonary orifice. Stenosis is rarer, while atresia is relatively more common, at the aortic than at the pulmonary orifice. As in the right side of the heart, the conus arteriosus may be narrowed, but the condition is rare. Stenosis of the aortic orifice is a much more serious condition than narrowing of the pulmonary orifice. Of 33 cases, only 1 survived the first month. Stenosis of the conus arteriosus, on the other hand, does not seem so serious, for the majority of cases have been observed in adults. The aorta itself may be narrowed at the insertion of the ductus arteriosus. In this case the blood current finds its way to the lower portion of the trunk and the lower extremities by a roundabout course through the dilated subclavian arteries and by their branches anastomosing with the intercostal and epigastric arteries. The arteries of the upper portion of the body may be demonstrated to be much larger and fuller than in the lower, as in a comparison between the radial and crural pulses. The prognosis of this developmental defect is good. The individual may live to advanced old age.

7. Transposition of the Arterial Trunks.—This anomaly is not of great interest to the practitioner, for it is usually associated with other grave developmental defects that make extra-uterine life unlikely, and, of itself, it leads to an early death. The vitiated blood flowing from the right auricle into the right ventricle is distributed by the aorta springing from this ventricle again to the body, while the aërated blood from the left auricle is conveyed back again to the lungs. Continued existence at all is usually explained by an open foramen ovale or by a communication between the pulmonary veins and the right side of the heart. Osler describes an example in an eight-months' fœtus, in which there was a partial transposition, the right ventricle giving off a small branch to the lungs, and the major part of its stream into the thoracic aorta, while from the left side sprang an arterial trunk that divided into the innominate and left carotid arteries. Children thus affected are deeply cyanosed, have dyspnœa, are prone to hæmorrhages and rapid cooling of the skin and the extremities. They are apathetic and die early. Twenty out of twenty-five cases did not survive the first year. A number of cases has been collected by Rauchfuss and Von Etlinger.

8. Numerical Anomalies of the Valve Segments.—The valve segments may be diminished in number by failure of development or as a result of endocarditis. Of itself this anomaly has little importance clinically, but it is often associated with other defects, as in the ventricular septum, and is commonly followed by sclerotic changes in the valves. Supernumerary valves are

not uncommon. As many as five semilunar valves have been observed. This is not likely to be accompanied by other abnormalities of the heart, and may have no clinical significance.

9. Ectopia cordis is the result usually of fissured sternum and thorax, and is commonly associated with a congenital fissure of the whole anterior body-wall. The heart may also be displaced upward into the neck or downward into the abdominal cavity. Other rare congenital malformations of the heart are found in acardia, ill-developed heart, double heart, bifid apex, and absence of the pericardium.

Symptoms.—The symptoms of all congenital heart defects have a certain general resemblance, as has been noted in their description under the appropriate divisions. Cyanosis is common, more or less, to them all. Indeed this term was long regarded as practically synonymous with congenital anomalies of the heart, but in the writer's experience the following conditions, arranged in the order of their frequency, have all been responsible for it: Pneumonia (often syphilitic); premature birth; asphyxia; atelectasis; degeneration of the blood; malformation of heart and blood-vessels; interference with the nerves of respiration; malformations of respiratory tract; congenital pleurisy, and partial occlusion of the trachea.

Treatment.—The treatment of congenital heart defects comprises hygienic management, protection from cold and physical exertion, and the administration of the heart tonics to tide over attacks of threatened cardiac failure and to help the development of a compensatory hypertrophy. Medicinal treatment alone, however, is of little avail, except to meet temporary indications. If compensatory hypertrophy is not soon established to a satisfactory degree, the prospect of life is bad.

ORGANIC DISEASES OF THE HEART.

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Diseases of the Heart during childhood present, in their general outlines, conditions very similar to those seen in the adult. In their details many and important differences occur. In the following pages these differences receive the chief attention, it being taken for granted that the reader is conversant with the diseases of the adult heart and their methods of detection. The following peculiarities are observed in the normal heart:

I. The apex lies higher in the chest and more to the left than in the adult, being outside the nipple line.

II. The apex-beat in the infant is usually difficult of detection; in the child it is more clearly visible, and can be detected by touch more readily than in the adult.

III. The area of dulness is comparatively large, so that the normal heart may, without caution, be considered hypertrophied.

IV. Murmurs are heard over a comparatively wide area, being frequently audible over the entire chest.

V. The rate may be increased and the rhythm disturbed by slight causes, so that rapidity and irregularity are of but little importance.

VI. In rachitic children, owing to deformity of the chest, the apex may appear in an abnormal position.

VII. Prominence of the præcordia is sometimes marked.

Cardiac disease during early life is also modified by the fact that the heart is undergoing numerous changes in growth and development. These are not constant, but occur chiefly at certain periods. The relative weight of the heart is greatest at birth, the right side predominating slightly over the left. During the first seven years there is an increase in volume of about 80 per cent. Between seven and fourteen the increase in actual volume is barely 10 per cent. There is then a very rapid increase of almost 100 per cent. These changes necessarily modify to a marked degree any diseased condition which may be present, and are of especial importance as regards prognosis and treatment.

I. Pericarditis.

Inflammation of the pericardium during childhood presents but few peculiarities pathologically. At this period of life inflammation of the serous membranes is more frequently marked by effusion than in the adult, and the pericardium presents no exception to the rule. Fluid forms with great rapidity, and is prone to be purulent. Endocarditis is a common accompaniment of pericarditis, and the walls of the heart are always more or less weakened. Not infrequently pericardium, endocardium, and muscle are all involved. Sturges, in extensive post-mortem observations, invariably found acute rheumatic endo-

carditis accompanied by more or less pericardial inflammation or adhesion, and believes that endopericarditis is the most common cardiac affection of early life. It is quite possible, however, that conditions present in cases so grave as to permit of post-mortem observation may not be as frequently present in the less serious cases which survive.

Etiology.—Pericarditis is seldom a primary affection. It may result from injury or the extension of inflammation from a neighboring organ, but more commonly occurs in the course of rheumatism or one of the infectious diseases. While rheumatism causes by far the greater number of cases, rheumatic pericarditis is not as common proportionately as in adult life. Scarlet fever, empyema, and pneumonia are frequent etiological factors. In young infants purulent pericarditis sometimes occurs as a result of septicæmic conditions at the umbilicus. Rheumatic pericarditis develops early, and sometimes precedes the articular symptoms. In scarlet fever the pericardial inflammation commonly develops during the second or third week.

Symptoms.—The subjective symptoms of pericarditis are usually obscure, and vary with the different stages of the disease. The early stage is frequently insidious and passes unrecognized. The most frequent symptoms are pain and palpitation. Pain may be confined to the præcordial region, or may be reflected into the shoulder or referred to the region of the stomach. It varies in intensity from a simple uneasiness to a sharp, lancinating pain. The patient sometimes assumes a characteristic position, with the head elevated and the body thrown somewhat toward the left. The trunk is held rigidly quiet, while the legs are moved freely. The pulse is full, and there may be slight fever and a hacking cough.

When effusion occurs the pain gives place to a sense of oppression. Respiration becomes labored, and the countenance assumes an anxious expression or a look of actual suffering. The face is livid or ashy pale. Dyspnœa is marked when the head is lowered. The pulse is weak, irregular, and intermitting. In fatal cases, as the effusion increases, attacks of syncope occur, hiccough develops, and delirium appears, followed by coma and death. In less severe cases præcordial heaviness and dyspnœa may be the only symptoms.

Physical Signs.—In the early stages the heart's action is usually forcible, but irritable, and often irregular. Percussion shows nothing except, perhaps, tenderness. A friction-sound is heard upon auscultation, the point of greatest intensity being, as a rule, under the fourth rib, just at the left of the sternum. This point varies with the position of the patient and with full inspiration. The sound is superficial, and has but a slight area of diffusion. It is frequently double, and usually creaking or rubbing in character, but may be crackling or even blowing. It sometimes so closely simulates the mitral regurgitant murmur as to be indistinguishable from it. Friction-sounds are more frequently absent in children than in adults, and rarely, when present, remain more than one or two days. The early detection of pericarditis in children is often one of the most difficult problems in the domain of physical diagnosis.

In the stage of effusion the difficulties in diagnosis are but slightly diminished. Owing to the thinness and yielding character of the chest-wall both the apex-beat and the normal heart-sounds may be readily detected when considerable fluid is present. In some instances the pulse is full and fairly strong, while the apex-beat is feeble or imperceptible. Occasionally an undulating impulse may be felt under the palm when the actual point of impact cannot be determined. Prominence of the præcordia is sometimes extreme. The area of percussion dulness is enlarged, but it is impossible to make definite statements as to its exact shape and extent. It is modified by the shape of the

chest, by pleuritic adhesions, and by pulmonary consolidation. If no adhesion or other lesion be present, the area of dulness assumes a somewhat pyramidal shape, being broad laterally at the lower portion and extending well up to the first rib. There is danger of mistaking an extremely dilated heart with feeble impulse for a pericardial effusion. Rotch, who has made a most careful series of observations upon the subject, calls attention to the fifth right interspace as a region of great importance in deciding between these two conditions. While with a dilated heart partial dulness may extend to the right of the sternum in the second or third interspace, it rarely appears in the fifth, and absolute dulness never. Even a small amount of effusion, on the other hand, finds its way into the fifth interspace, causing absolute dulness. Upon the left of the sternum the area of dulness in the two conditions is almost identical.

In the late stages, when recovery takes place, there are no physical signs by which pericardial adhesions may be positively detected. Intermittent or disturbed cardiac action following a pericarditis without evidence of an endocardial lesion offers strong presumption that such adhesions exist. According to Sturges, a rubbing exocardial sound does not preclude the possibility of pericardial adhesion.

Prognosis.—In infancy pericarditis is a serious and usually fatal disease. During childhood the tendency is to recovery. Not infrequently the course is rapid, complete resolution taking place within ten days. In other cases, while ultimate recovery is complete, it is long delayed. In still others adhesions remain which seriously cripple the heart. When the formation of fluid is rapid, embarrassment of the heart's action becomes alarming and sudden death may occur. Myocarditis is a frequent and serious source of danger. The longer the effusion is present the greater this danger becomes. The dilatation resulting from myocarditis is sometimes extreme, but if the child is in fair general condition hypertrophy follows, and is usually fully compensatory.

Treatment.—Any constitutional condition to which pericarditis may be secondary should be brought under control as quickly as possible. Pain and cardiac irritability should be at once relieved. For this purpose opium stands without a rival, and is the most important agent in the treatment of pericarditis. Sufficient should be given to relieve pain and maintain a mild continuous effect through the early stages. Though it may be administered more freely than in endocarditis, the condition of narcotism should never be induced. Stimulants are indicated when the pulse becomes feeble and weak. In attacks of syncope quickly-acting stimulants like Hoffman's anodyne are demanded. Digitalis aids materially in maintaining the integrity of the heart-muscle, and in most cases is a drug of much value. Occasionally, when there are extensive adhesions, it causes palpitation and increased irregularity, and must be discontinued.

Locally, poultices or large hot anodyne applications are preferable to the ice-water coil. Blisters should never be employed. Absorption is sometimes hastened by mercurial ointment applied upon flannel over the præcordia.

Nutrition should be maintained at the highest possible point, but overloading of the stomach must be carefully guarded against. After the acute stages tonics are usually indicated, for pericarditis is eminently a disease of the weak, anæmic, and feeble. Absolute rest cannot be too strongly insisted upon. Care in this direction should not be relaxed while the slightest evidence of impaired cardiac action remains. In no other condition is weakening of the heart-muscle so common. Weeks, or even months, must sometimes elapse before active exercise can be safely permitted.

When the amount of fluid becomes so great as to seriously threaten life,

paracentesis is demanded. Death, however, very rarely results from pressure. Urgent symptoms are often transient, and disappear without mechanical interference. Much has been said regarding the harmlessness of the operation, but it is not without serious dangers. It should be resorted to, however, when the fluid is found to be purulent or so excessive in quantity as to endanger life. Dieulafoy's or Potain's aspirator should be employed with a Fitch needle, which has a protector to be pushed over the point after it is introduced, thus avoiding the danger of puncturing the heart-wall. The fluid should be completely removed. The fifth intercostal space, just to the left of the sternum, is the point usually advised as the seat of puncture. Rotch, however, proposes the fifth intercostal space of the right side as preferable, since it would here be impossible to puncture a dilated heart—an accident which might occur on the left side.

II. Acute Endocarditis.

Inflammation of the endocardium is a frequent disease of early life. During fœtal life the right side of the heart is usually involved, after birth the left side. During childhood the serous membranes are especially sensitive, and there is a marked tendency in the connective tissue to cell-proliferation. Morbid changes are chiefly confined to the valves and chordæ tendineæ, but in some instances the whole endocardium is implicated. As a rule, the fibrous structure of the valves bears the brunt of the attack. The valves are simply folds of serous membrane bound together by fibrous tissue. Inflammation is attended by proliferation of cells within the endocardium, pushing it up into papillary elevations, and also by proliferation of the fibrous tissue itself. This latter change is the most characteristic and important process in endocardial inflammation. The whole valve becomes thickened and stiff, and the chordæ tendineæ are affected in a similar manner. Nodules are most numerous along the edges of the valves, where they form rows of reddish semi-translucent beads. As they lie directly in the blood-current, fibrin is gradually deposited, forming the so-called vegetations. They may become so large as to cause serious mechanical interference with valvular action, or portions may be detached and swept into the circulation. Even when these vegetations are quite numerous they may undergo resolution and disappear, but when marked hyperplasia of connective tissue has occurred, the almost inevitable result is contraction, with consequent puckering, thickening, and distortion of the valves, shortening of the chordæ, or narrowing of the valvular openings.

Etiology.—Sex cannot properly be called an etiological factor of endocarditis, although twice as many girls suffer from heart disease as boys. A boy who has rheumatism is as liable to a cardiac complication as a girl, but girls are more subject to rheumatism than boys. Of my own cases, 38 per cent. were boys, 62 per cent. girls, the preponderance of girls being greatest under eight years.

Age is a more important factor. Endocarditis occurs in infancy, and even in intra-uterine life, but it is rare under five years. It is probably more common during the three years between eight and eleven than at any other similar period of life.

Rheumatism is by far the most important exciting cause of endocardial inflammation, but in children that disease is so uncertain in its manifestations that it is readily overlooked. In the majority of cases it appears in a form which in the adult would be designated as subacute. But the mildest and most transient attacks are not infrequently accompanied by inflammation of

the endocardium, which would be overlooked without physical examination. No attack of joint-pain in a child is too mild to preclude the possibility of an accompanying endocarditis. I have seen it develop during the course of torticollis in a child of rheumatic parentage. Among 117 cases of cardiac disease, I found rheumatism, either antecedent, concurrent, or subsequent, in 82 per cent. A definite family history of rheumatism was obtained in 57 per cent., excluding grandparents. Attention has been directed to the importance of subcutaneous fibrous nodules in the diagnosis of rheumatism, and it is believed that similar nodules form at the same time on the cardiac valves. While they are strongly suggestive of endocarditis, they give no positive evidence of that condition. I have seen a profuse crop of nodules develop without the slightest evidence of cardiac disturbance.

While the intimate association of chorea and heart disease is well known, the exact etiological relationship is still uncertain. Occasionally endocarditis developing during a choreic attack disappears as the chorea subsides; more commonly it leaves a permanent lesion. In the great majority of cases the murmur is not functional, but organic, and is due to well-defined pathological changes in the valves. Thirty per cent. of my cases of cardiac disease suffered at some period of their lives from chorea, but 24 per cent. gave also a clear history of rheumatism. Although in the remaining cases no positive history of rheumatism could be obtained, there is ground for belief that the endocarditis of chorea is, in fact, rheumatic.

Scarlet fever is occasionally complicated by endocarditis. In rare instances it appears early in the disease, but more commonly develops during the stage of desquamation. It usually appears in patients showing evidence of nephritis, and is probably due more to uræmia than to the poison of scarlatina. Diphtheria, measles, erysipelas, and septicæmia are occasionally complicated by inflammation of the endocardium.

Symptoms.—Endocarditis is a very obscure disease. The symptoms are few in number and occur in no fixed order. They may be wholly wanting, and the disease may run its course without presenting any appreciable symptom. The symptoms of the acute disorder during which it develops often mask or wholly obscure those of the cardiac complication. When accompanying a rheumatic attack there is frequently an increase in temperature, or slight fever appears if none has previously been present. The child seems more ill than the arthritis would account for. There may be a peculiar restless, anxious expression, with a tendency to cyanosis. The heart's action is disturbed and the pulse becomes very rapid The symptoms depend largely upon the amount of myocarditis present. If the muscular tissue is much involved, palpitation, præcordial distress, cyanosis, and dyspnœa will be marked. In milder and more common cases none of these symptoms are present to draw attention to the heart. Anæmia is a very constant accompaniment of endocardial inflammation, and develops rapidly. The appearance of subcutaneous fibrous nodules should always lead to a physical examination of the heart.

The tendency to recurrence is a marked feature of endocarditis. An endocardium that has once been inflamed is far more sensitive thereafter to irritating blood-conditions. Fresh attacks are readily lighted up by slight causes.

The occurrence of an embolism first directs attention to the heart in some cases. The spleen is the organ most frequently affected. The most distinctive symptoms result from embolism of the brain, the middle cerebral artery of the left side being commonly the seat of lesion, with resulting hemiplegia and aphasia. Embolic pneumonia occurs in the child as in the adult.

Physical Signs.—The signs obtained by physical examination are the

only means of positive diagnosis. An endocarditis may, in rare instances, be present for several days, or even run its course, without developing a murmur. Occasionally abnormal sounds, as roughness, muffling, or prolongation of the first sound, precede an actual murmur. In most cases the murmur is heard only at the apex. It is systolic, soft, and blowing, differing from the ordinary mitral regurgitant in its limited area of conduction. It is more intense at the apex, but it is not transmitted far to the right, and is rarely audible behind. It usually appears early in an attack of rheumatism, and is organic. It sometimes disappears, leaving no valvular lesion. A similar murmur occasionally appears late in the course of typhoid fever, and is probably due to muscular insufficiency the result of anæmia or myocarditis. The murmur of scarlatina, chorea, and rheumatism is usually entirely different in character.

Other sounds are heard at the apex much more frequently in children than in adults. Of these reduplication of the second sound is most important. Reduplication of the second sound at the base is frequently heard in Bright's disease of the adult, but as heard at the apex in children it is probably due to asynchronous action of the mitral and tricuspid valves, the result of stiffening of the mitral. It is almost a certain forerunner of a mitral obstructive murmur. Sometimes a soft blowing murmur is heard immediately after the second portion of the double sound. This gradually increases in length and intensity, and develops the well-known rumbling murmur of mitral stenosis. In very rare instances an aortic murmur develops early in endocardial inflammation, either alone or in connection with a mitral murmur. The same is also true of tricuspid regurgitation.

When acute endocarditis is engrafted upon an old valvular lesion, its diagnosis is especially difficult. If the patient has been under observation and the character of the murmurs is known, diagnosis is easy. Marked enlargement of the heart is strong proof of an old lesion. Extreme subjective symptoms of cardiac disease, especially œdema, are rarely seen in primary endocarditis, but in chronic heart disease the symptoms are all aggravated by a fresh endocardial attack. The character of the murmur may furnish some aid in diagnosis, but cannot be relied upon. A soft blowing murmur is usually recent; if harsh, musical, or rough, it is probably old.

Prognosis.—As endocarditis is not an idiopathic disease, the prognosis depends largely upon the condition with which it is associated. A first attack is rarely the direct cause of death. It is extremely variable in its course. It may pass away, leaving no lesion or murmur, but more frequently a valvular lesion is left behind. If the pulse becomes feeble, and the child loses strength and grows rapidly anæmic, the prognosis is bad. It is bad if recurring attacks of rheumatism appear or if fibrous nodules recur in successive crops. Endocarditis appearing during the course of a septic disease is usually ulcerative in character, and the prognosis is extremely unfavorable. Early involvement of the aortic valves is also unfavorable. It is not wise to give a too favorable prognosis at first, especially as to duration, for exposure or lack of rest will materially prolong an attack. Duration is more uncertain in children than in adults. Loudness of the murmur is of but little importance, but the greater the number of murmurs the more serious is the condition. The murmur appearing during chorea occasionally disappears as the choreic movements subside. This is sometimes apparent rather than real. After a time a murmur which has almost disappeared may return and continue permanently—a result that is probably due to the lighting up of a fresh valvulitis, consequent upon the occurrence of a mild rheumatic or choreic attack. On the whole, the ultimate prognosis is rather better in children than in adults. Tissue-growth is so

rapid and compensation becomes so complete that an endocarditis of not excessive severity may produce but little permanent injury.

Treatment.—The constitutional disease with which endocarditis is associated should receive prompt attention. In the treatment of rheumatism it is not sufficient to direct our efforts simply to the control of the arthritis and relief of pain. The possibility of endocarditis must also be considered. The ideal treatment is that which controls the arthritis, reduces fever, relieves the pain, and, above all, prevents cardiac complications. In my experience the ordinary treatment with salicylate of sodium has not fulfilled these requirements, for it has not perceptibly removed the danger of endocardial inflammation. A patient fully under the influence of the salicylate will not infrequently develop a cardiac murmur—an accident which occurs much less frequently under the alkaline treatment. In view of the great susceptibility of the endocardium in childhood a judicious combination of the salicylates and alkalies offers the safest and most efficient treatment. If endocarditis develops, the salicylate should be dropped or administered with the utmost caution.

Treatment for the purpose of affecting the endocardium directly is of but little avail, yet much may be accomplished by drugs. It is important that the rapidity and irritability of the heart be lessened, and that a condition of cardiac rest be attained as far as possible. Aconite lessens the rapidity, but it also weakens the force, and with children is an unsafe drug. Digitalis must be used cautiously. In acute endocarditis developing in an old cardiac case it is often of supreme value. When the heart's action is tumultuous, but rapid and weak, it may be given with the most satisfactory results, as it reduces the frequency, increases the force, and corrects the irregularity. A child of six years may take four drops of the tincture every four hours for one or two days, when the dose should be diminished. Opium is also of great value in rheumatic endocarditis. It not only relieves the articular pain, thus rendering general bodily quiet possible, but it has a most happy effect in steadying and quieting an irritable, irregular, and rapid heart. Two minims or more of the deodorized tincture may be given every four to six hours at six years. When pericarditis is also present opium is the sheet-anchor. Stimulants should be avoided until definitely indicated. When dilatation is marked they are demanded, and must be administered freely. When the fever has abated a tonic is indicated, for anæmia appears early, and is frequently persistent and extreme. Citrate of iron and quinine is admirably adapted to these cases, and may be given in doses of three to four grains three times a day. The bitter wine of iron is also an excellent preparation. One or two drops of Fowler's solution may be added, but full doses of arsenic are inadvisable. When the fever ranges high during the acute stages, quinine may be given in moderate doses, but antipyrine and acetanilide are too depressing to be employed with safety. Phenacetin is, perhaps, admissible. Administered in small doses it is an excellent analgesic.

Absolute rest and protection of the surface from cold and dampness are of far more importance than medicinal treatment. Without these precautions treatment is of little avail in preventing permanent valvular lesions. The child should wear a flannel jacket or night-dress, and be placed between flannel blankets instead of the usual sheets. Even in mild cases of acute endocarditis strict rest should be enjoined and insisted upon long after every rheumatic and cardiac symptom has disappeared. If a permanent murmur results, it is often difficult to determine when it is safe for the child to leave the bed and resume play, but it is wise to err on the side of caution. This enforced rest is, perhaps, the most difficult of accomplishment of any measure in the treatment

of children, particularly in families where discipline is lax. It can be obtained with almost any child with determination and patience, and when the importance is so great these qualities should certainly not be lacking.

Local applications, while less efficacious than in pericarditis, are of considerable value. Poultices sometimes give marked relief from præcordial distress, but caution must be exercised to prevent chilling of the surface. The application of a weak chloroform liniment upon flannel held in position by a flannel band is safer and accomplishes fully as much. The chest should always be closely protected with flannel.

III. Chronic Heart Disease.

Chronic valvular disease is the sequel of acute endocarditis. The lesions in childhood do not differ materially from those of the adult. Thickening and distortion of the valves are the changes most frequently observed, but vegetations occasionally appear. They are most common on the auricular surface of the mitral valve. Adherent pericardium, the result of previous pericarditis, is very common, while hypertrophy of the cardiac wall is more frequent and extensive than in later life.

Etiology.—Acquired valvular lesions result from acute endocardial inflammation. The causes of such inflammation are considered in detail in their appropriate place.

Clinical History.—Cardiac disease presents three conditions or periods:

1. Period of acute inflammation.
2. Period of compensation.
3. Period of heart failure.

It must not be supposed that these conditions always follow each other in the order mentioned, or that the disease runs a course through three definite stages to a fatal termination. This may occur, but more frequently the first condition is several times repeated, and the third is often transformed into the second by rest and treatment. Compensation occurs with great rapidity and completeness in children. Failure of compensation never occurs without cause. The most frequent causes are anæmia and impaired general nutrition; acute intercurrent diseases, particularly rheumatism with endocarditis; and sudden heart-strain from excessive muscular exertion.

Symptoms.—When compensation is perfect there are no symptoms. It not infrequently happens, therefore, that a murmur is discovered when there is nothing whatever in the child's history or appearance to direct attention to the heart. Dyspnœa is by far the most frequent symptom, with palpitation but little less common. They are most marked when the aortic valves are involved, but dyspnœa on exertion is usually present with mitral stenosis. Pain as an urgent symptom is not common, and is more frequently associated with mitral stenosis than with any other cardiac lesion. Cyanosis and œdema are rare, and do not appear until other symptoms become urgent. Œdema rarely pursues a typical ascending course. Epistaxis is not uncommon. Persistent cough and subacute bronchitis are frequent accompaniments of mitral stenosis. The condition often observed in the adult, marked by dyspnœa so extreme as to prevent sleep, by tumultuous palpitation and extreme cardiac distress, cyanosis, and dropsy, is rarely seen under twelve years.

Mitral Regurgitation.—Imperfect closure at the mitral orifice is the most common cardiac defect during childhood. It usually results from pathological change in the valves, but may be due to dilatation of the ventricle causing a failure of coaptation of the edge of the valves. The murmur is systolic, is

heard with greatest intensity at the apex, and is conveyed to the left. Such a murmur developing during the course of a rheumatic endocarditis is organic and probably permanent. If developed under other conditions it may quickly disappear. The great relative frequency of this murmur is shown by the following table, compiled from my own history books:

Mitral regurgitation in	131	cases	(94.7	per cent.),	alone in	99	cases.
Mitral obstruction	"	17	"	11.8	"	"	"	4	"
Aortic regurgitation	"	9	"	6.3	"	"	"	0	"
Aortic obstruction	"	28	"	20.1	"	"	"	3	"

Mitral Stenosis.—The frequency of the presystolic mitral murmur in childhood is comparatively great. In my cases it occurred in relation to mitral regurgitation as 1 to 7.71. Rheumatism was a factor in its production, but was less strongly marked than in either of the other murmurs, confirming the statement of Sansom that mitral stenosis is intimately associated with rheumatism, but most frequently with insidious varieties. Symptoms are somewhat more marked than in simple mitral regurgitation. Pain is more common than with any other lesion, and dyspnœa on exertion is the rule. Palpitation is also common, while bronchitis and cough are frequent and obstinate. The mitral obstructive murmur is very rare in infancy. I have never seen it under five years. It is slow in its appearance, never developing suddenly, as does the mitral regurgitant. The character of the abnormal sound is subject to change from time to time—more so than any other murmur. It may become very faint or even imperceptible, but it is very sure to return, and hopes based on its disappearance are almost certain to be disappointed. Frequently there is no perceptible cause for this changeability.

The mitral obstructive is probably more frequently overlooked than any other murmur, yet it is quite distinct and characteristic. It is, as a rule, harsh and of a rattling, blubbering character. It differs decidedly from other murmurs in one particular: instead of rising to a maximum, and then gradually decreasing or shading off into silence, it rises rapidly to a maximum, and suddenly ceases as the apex strikes the chest-wall. Its area of diffusion is limited. As the stethoscope is carried from the apex a point is quickly reached at which the murmur suddenly and completely ceases. If a regurgitant murmur is also present and the heart is acting rapidly, the two murmurs may run so closely together as to be with difficulty separated. In this case the first portion, or obstructive murmur, suddenly ceases at a given point, while the regurgitant remains unchanged. If the second sound is reduplicated at the apex, the certainty of mitral stenosis is increased. A thrill is by no means so common as in the adult. It is sometimes absent in well-marked cases, and is occasionally present when the murmur is faint and uncertain. The left auricle is dilated and hypertrophied in cases of long standing, and the right side of the heart is engorged and frequently dilated. Right-side enlargement, however, cannot always be determined by physical examination.

Aortic Stenosis.—Aortic murmurs are much more definitely associated with rheumatic histories than are the mitral, and indicate a more extensive endocarditis. An aortic obstructive murmur may permanently disappear. This has occurred in my own experience twice, two years being required in one case and over three years in the other. A change in character is not uncommon, a loud, harsh murmur becoming soft and blowing or even disappearing temporarily. While symptoms are in many cases obscure, they are, as a rule, somewhat more distinctive than when mitral regurgitation alone is present, it being remembered that a mitral murmur is almost invariably an accompaniment of the aortic. Dyspnœa is frequent, and with a double aortic

murmur dyspnœa and palpitation upon exertion are almost constant. Both symptoms are more continuous, and depend less upon exertion than in the case of mitral disease. Anæmia is very common; it is persistent and often extreme. Physical signs differ but little from those observed in the adult.

Aortic Regurgitation.—This is the most infrequent left-side valvular lesion. It rarely, if ever, occurs alone in childhood, and in but one instance have I heard a double aortic murmur without an accompanying mitral. The symptoms are somewhat more marked than those of simple aortic stenosis, for it appears only after extensive endocardial inflammation, and is an additional burden to an already disabled heart.

Tricuspid Regurgitation.—This condition is more frequently detected by the pathologist than by the clinician, because in the young it is extremely difficult of differentiation from mitral regurgitation. In early infancy a murmur heard with greatest intensity at or just to the right of the apex is presumably tricuspid. If the lesion is serious, right-side enlargement will be present, which may be detected by an area of dulness at the right of the sternum and by epigastric pulsation. When added to mitral and aortic disease the symptoms are distinctive. Visceral enlargements and dyspepsia are invariably present, but jugular pulsation is not constant. Palpitation, dyspnœa, cough, pain, cyanosis, and œdema develop to form the last stage of a fatal malady.

Prognosis.—The elements of prognosis are numerous and complicated. Murmurs alone usually furnish insufficient evidence upon which to base an opinion. The action of the heart, the condition of hypertrophy or dilatation, the completeness of compensation, and the general physical condition of the patient must all be taken into account. The social condition, surroundings, and mode of life are important factors and must be duly considered. Parental discipline is also an element of great importance. In a wayward and uncontrolled child the prognosis is decidedly worse than in one under firm and judicious discipline. On the whole, the prognosis may be said to be better in the child than in the adult.

The period from ten to fifteen years is a critical one. The remarkable increase in the volume of the heart at the time of puberty has already been referred to. A patient sometimes progresses satisfactorily till this age is reached, when the whole aspect of the case is changed. Compensation becomes imperfect, the child grows anæmic, and gives evidence of impaired nutrition. Development is retarded, though there may be growth in height, the child being thin and without strength or vigor. Sometimes he develops into a fairly healthy youth, but in other cases, going from bad to worse, finally succumbs. Fortunately, the majority of patients pass safely through this trying period, often without perceptible inconvenience. Such children, if a mitral regurgitation only is present, usually develop into healthy men and women and never show symptoms of cardiac disease.

The etiology aids somewhat in prognosis. The more distinctly rheumatic the patient, the worse the prognosis, for recurring attacks of endocarditis are to be feared. Failure of compensation resulting from an attack of rheumatism or scarlet fever is of far greater importance than that developing from muscular strain, anæmia, over-study, or nervous excitability. Among symptoms cyanosis and œdema are of the most serious import.

If mitral regurgitation alone is present and the child is strong and well-nourished, the probability of maintaining compensation is good, provided recurring attacks of endocarditis can be prevented. The prognosis turns almost entirely upon this last contingency, and this, in turn, depends in large measure upon the personal and family history as regards rheumatism. Hence

the history is a matter of decided importance in prognosis. Mitral stenosis is always a grave condition, but is somewhat less serious in young children than in adults, largely because the pulmonary arteries adapt themselves more readily to the abnormal strain placed upon them. Compensation sometimes becomes perfect, and remains so, but when the lesion is extreme, it does not admit of complete and permanent compensation. When pulmonary symptoms are marked the prognosis is especially bad. In aortic disease, if obstruction alone is present, without rheumatic history, the prognosis is very favorable. The murmur may entirely disappear. If, on the other hand, it is associated with a mitral murmur and a rheumatic history is obtained, the case is a grave one: the disease is the result of an extensive endocarditis, which will probably recur to cause more and more distortion of the valves. Aortic regurgitation is a far more serious condition than aortic stenosis, and when both murmurs accompany a mitral the prognosis must be very guarded. Tricuspid regurgitation is always a serious condition, and the prognosis is unfavorable.

Treatment.—The successful management of cardiac disease requires, on the part of the physician, a clear conception of its various stages and an understanding of the exact condition of his patient. If the compensation is perfect, there will be no symptoms of heart disease and nothing to treat. All that can be accomplished in any case not suffering from acute inflammation is to establish compensation. If that is already accomplished, it is the height of impropriety to treat the patient for heart disease. The error must not be made upon the other extreme, however, that the physician has no duty in the case. The child should be kept under observation, for the condition of compensation may be at any time changed to that of heart failure. Nutrition should be maintained at the highest possible point by diet and properly regulated outdoor exercise. The child should be especially guarded against exposure to the exanthematous diseases, and, above all else, should be protected from conditions which tend to precipitate an attack of rheumatism. If that disease does develop, it should receive prompt and vigorous treatment. Anæmia is a condition full of peril in heart disease, for when it is extreme compensation is not long maintained. It should be combated by iron, arsenic, cod-liver oil, the vegetable bitters, and a generous but simple and digestible diet. The question of exercise is one of the greatest importance. Violent games may do irreparable harm, while, on the other hand, if the child be debarred from reasonable outdoor exercise, heart failure may develop from anæmia and impaired general nutrition. Quiet games and plays are to be definitely prescribed, with the strictest injunction against football, baseball, and all games requiring violent muscular exertion and running. The clothing should also receive the physician's attention, flannels being prescribed for both summer and winter.

If failure of compensation appears, absolute rest should be rigidly enforced. The cause should be sought and removed if possible. The appetite usually disappears utterly, and the stomach becomes irritable and enforced alimentation is necessary. If the stomach rejects milk and lime-water, animal broths, or koumyss, it may retain milk peptonized for two hours, to which a little lemon-juice may be added. If this is rejected, nutritive enemata of completely peptonized milk must be given every four to six hours. Medical treatment will prove of little avail if the child is permitted to lose strength from lack of nourishment.

Among drugs digitalis still holds its position as first and most important, but it must be employed judiciously. Much harm may result from lack of judgment and nice discrimination in the use of the cardiac stimulants and sedatives. By increasing the force of the systole, prolonging the diastole, and contracting

relaxed arterioles digitalis restores the balance of the circulation when deranged by valvular lesions or weakness of the heart-muscle; in other words, it re-establishes compensation. Its use is indicated when the heart's action is rapid, feeble, and irregular and the pulse shows low arterial tension. Rational symptoms offer more reliable indications for its use than do the physical signs, but both should be duly considered. Dyspnœa, cough, cyanosis, œdema, and scanty urine are indicative of failing heart-power, and call for a cardiac stimulant. Mitral regurgitation is the valvular lesion for which digitalis proves most generally useful. With mitral stenosis irregular heart action is sometimes aggravated by its use. In that case convallaria may prove efficient. When an aortic murmur is present digitalis is not so frequently efficacious as in mitral disease alone. If compensation is good, its use may cause alarming symptoms, and in any case it should be prescribed cautiously at first. Iron, strychnine, and the alkalies are, as a rule, more efficacious. In tricuspid regurgitation digitalis must be used with extreme caution. The tincture is the preparation most commonly employed, the dose varying according to the age and cardiac condition from one to five or six minims. It is often very badly tolerated by the stomach. The solid preparations cause far less gastric disturbance, and may be usually continued for weeks without trouble. The dose of the powdered leaves is from one-fourth grain to one-half grain, and of the extract one-fourth of these amounts.

In case of great restlessness on the part of the child, with palpitation and cardiac distress, a sedative may be required. Bromide of sodium should be first tried in doses of three to ten grains every six hours. If this be unavailing, opium may be cautiously administered, paregoric being selected for younger children, and the deodorized tincture for those of more advanced years. Excessive palpitation, with dyspnœa appearing in paroxysms, is often quickly relieved by a few drops of compound spirits of ether combined with a small dose of opium.

If the urine becomes scanty and œdema appears, a hot digitalis poultice should be applied across the loins. This is made by boiling two ounces of digitalis leaves in a pint of water, and then stirring in sufficient linseed meal. Digitalis should be administered freely, and in this condition the infusion is most effectual. At the same time the bowels should be freely acted upon by calomel. The compound diuretic pill for children who can swallow it often relieves the symptoms with marvellous rapidity. It consists of equal parts of calomel, digitalis, and squill; one-third to one-half grain of each may be given at twelve years. For younger children the tincture of digitalis and tincture of squill may be combined with spirit of nitrous ether or citrate of potassium.

THE FUNCTIONAL AFFECTIONS OF THE HEART (THE CARDIAC NEUROSES).

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The functional affections of the heart include those motor and sensory derangements which occur in the absence of demonstrable anatomical changes in the organ.

The qualifying adjective "functional" is used in its ordinary sense, to denote the absence of anatomical lesions demonstrable during life or after death. It is appropriately employed in this connection to designate disorders not primarily of the heart itself, but rather of its innervation. Hence these affections are also properly spoken of as cardiac neuroses.

It is important to note that all the morbid phenomena observed in functional disorders may and frequently do attend the structural diseases of the heart.

The functional affections of the heart which occur in childhood are—

A. Motor:
   1. Derangements of rhythm.
      a. Arrhythmia.
      b. Rapid heart—tachycardia.
      c. Slow heart—bradycardia (brachycardia).
   2. Momentary arrest—syncope.

B. Sensory:
   Subjective sensations referred to the præcordia.
      a. Heart-consciousness.
      b. Distress.
      c. Pain.

C. Motor and Sensory combined:
   Palpitation.

Etiology.—The influences which predispose to affections of the heart are the same in childhood as in adult life. They consist in (*a*) a weak and delicate organization associated with an impressionable nervous system; (*b*) anæmic conditions; (*c*) lithæmia and allied derangements of metabolism and excretion; and (*d*) morbid conditions directly affecting the nervous system, as organic diseases of the brain and cord, chorea, epilepsy, and the acute and chronic infections. To this list must be added adenoid hypertrophies of the pharyngeal vault.

Certain of these conditions are inherited, others acquired. Thus the children of nervous or insane parents, those begotten of elderly persons, those born prematurely, those who have in infancy been exposed to privation and neglect, or who have suffered from serious or protracted disease, are especially prone to functional disturbances of the heart. To a less extent is this true of the

children of gouty families and of the offspring of tuberculous and syphilitic parents. The tendency to functional cardiac trouble, rarely observed in early infancy, usually shows itself at the approach of the seventh or eighth year.

The exciting causes include (A) those acting upon the nervous system; (*a*) directly, as intense mental emotion, fever, anger, passionate grief; or (*b*) reflexly, as dentition, gastro-intestinal irritation from indigestion, intestinal worms, foreign bodies in the intestinal canal; and (B) those acting, by means of mechanical disturbance of the circulation, upon the heart, as violent exercise or exertion, especially after meals.

Functional derangements of the heart are much less frequent in childhood than in adult life, for the reason that the Pandora's box of vicious habits, the brunt of which the heart must sooner or later bear, is only opened by degrees, and, happily, not often early in life.

Symptoms.—In general terms the symptoms of the functional disorders of the heart in childhood, as in adults, consist in derangement of the motor functions and abnormal sensations referred to the præcordia. These motor and sensory derangements are not always associated. More commonly the movement of the heart is deranged, its action being accelerated, retarded, or irregular, without abnormal sensations; occasionally deranged rhythm of frequency occurs in connection with præcordial distress or pain or a sense of oppression, and in comparatively rare instances præcordial pain occurs in the absence of perturbation of the movements. Angina pectoris is not a disease of childhood, nor is it common to encounter the agonizing pains of pseudo-angina early in life.

When the functional disorder is paroxysmal or of a high grade of intensity, it is usually accompanied by increased frequency and shallowness of respiration, and very often by pallor of the face and slight cyanosis. Especially is pallor associated with the temporary arrest of the heart's action known as fainting, a condition also usually preceded by momentary nausea.

The child, ignorant alike of the existence of his heart and of its functions, uncomfortable as he may be in other respects, escapes the anxiety and mental distress which in the adult forms so important an element in the paroxysmal functional affections of this organ.

When the derangement is not paroxysmal, but persistent, the rhythm of the respiration is not usually disturbed.

It is to be borne in mind that in childhood both the respiration and the action of the heart are normally far less constant in rhythm than in adults, that they are more readily deranged by slight causes, and that the action of the heart is often irregular during sleep and much influenced by inspiration and expiration. The *pulsus paradoxus*, in which the heart-beats during inspiration are more frequent, but less full, than during expiration, may often be observed in perfectly healthy children during sleep.

Physical examination yields a limited number of definite signs. The frequency of the heart's action and the degree and character of the arrhythmia are recognized upon palpation. By this method of examination we also detect, especially on palpation, the change in the character of the impulse, which is increased in force. We observe also by this means and by inspection that the impulse is extended. We determine by the position of the apex-beat, and may confirm by percussion, the observation that the heart is not enlarged. Upon auscultation the first sound is found to be sharp and valvular and shortened in duration, while the second sound remains distinct or is accentuated. In very rapidly-acting or very irregular hearts transient murmurs, usually mitral systolic, sometimes develop.

Arrhythmia.—The various forms of arrhythmia are encountered in the functional cardiac affections of childhood. The paradoxical pulse, as has been mentioned, is frequently observed in healthy children during sleep. When encountered during the waking hours it is more frequently a manifestation of organic than functional derangement of the heart.

The rhythm of the fœtal heart, embryocardia, a condition in which the acoustic properties of the two sounds are almost identical and the pauses nearly equal in duration, frequently occurs when the heart's action is rapid. Other forms of arrhythmia, as the alternate heart-beat in which strong and weak contractions occur with regular alternation, the bigeminal and trigeminal pulsation in which the ventricular contractions occur in series of two or three separated by an interval or by feebler contraction, the gallop rhythm and dicrotism, are rarely observed. The disturbances of rhythm in which with rapid action there is irregularity, not conforming to definite type, are the most common. This condition in its more marked degrees has been described under the term *delirium cordis*. With less rapidity of action there may be recognized, upon physical examination, short series of three or four forcible heart contractions followed by great irregularity and feebleness of action, this succession being irregularly repeated. True intermission or the missing of a cardiac beat—"heart dropping," as it is frequently called, a condition common in adult life—has not come under my observation in childhood.

Rapid Heart (*Tachycardia*).—The action of the heart, normally 130 to 140 per minute in the new-born, gradually decreases in frequency until the end of the third year, when it ranges about 90. It is readily accelerated by slight causes. Great increase in the rapidity of the heart's action is encountered in fevers. Rapidity of the heart is also induced by violent emotion and undue exercise. The rapid action thus induced may sometimes persist for hours or days. The paroxysmal tachycardia occasionally encountered in adults does not occur in children.

Slow Heart (*Bradycardia*, *Brachycardia*).—This condition is not common in childhood. Slowness of the pulse, the rate falling to 60 or somewhat below it, is, however, occasionally encountered during convalescence from the acute infectious diseases, in acute rheumatism, in disorders of the digestive system, in jaundice, and in anæmia. Slowness of the heart's action has been observed in post-epileptic coma.

Syncope occasionally occurs in nervous and impressionable children. It may result from sudden shock or intense excitement. On several occasions I have known children of six or seven years of age to faint at the sight of blood. I have seen a boy of seven faint at the sight of the denuded spot upon his arm caused by vaccination. A healthy girl eight years old, of shy and timid disposition, fainted at the dinner-table upon being suddenly addressed by a person whom she did not know. For some hours she remained quiet upon the sofa, the pulse-rate not exceeding 60. Actual loss of blood, even when slight, profuse diarrhœa, extreme fatigue, and severe pain are capable of producing syncope in impressionable children.

Heart Consciousness is fortunately extremely rare in children. The most tumultuous action of the heart may take place apparently without subjective sensations. It occasionally happens, however, that older children complain of the beating of the heart without pain under conditions of excitement or fatigue and in the absence of over-action amounting to palpitation.

Præcordial Distress is occasionally encountered. It is usually reflex in character and caused by gastro-intestinal irritation. As a rule it is transient.

Præcordial Pain is rare. A remarkable instance of distressing præcordial

pain in a lad has come under my notice. The patient was the feebler one of twins, and suffered in various ways from the reflex nervous disturbances due to adenoid vegetations in the pharyngeal vault. Among these were attacks of pain in the region of the heart, unaccompanied by disturbances of rhythm or over-action, and occurring in paroxysms repeated on several successive days.

PALPITATION may be defined as over-action of the heart with abnormal præcordial sensations. These sensations are always distressing and very frequently amount to actual pain. Palpitation is attended by increased rapidity of respiration and a sense of oppression. It is among the more common of the functional heart affections of childhood, usually induced by over-exertion or violent emotions, and sometimes occurring without recognizable cause. The condition of convalescence from acute disease, debility, anæmia, and lithæmia are predisposing influences.

Course.—The course of the functional affections of the heart in childhood is in the main transient. If recurrences take place, they gradually cease as the general health improves. This is especially true of the attacks which occur as the result of reflex gastro-intestinal derangements, of anæmia, or during the convalescence from acute disease. The attacks which are met with in constitutionally feeble children, in those who are lithæmic or who have habitually an abundance of calcium-oxalate crystals in the urine, yield less readily and more slowly to treatment. The mere "impressionable heart" is likely to be functionally deranged by slight causes throughout life. It is not, however, incompatible with fairly good general health and a reasonable expectancy of life.

Diagnosis.—The diagnosis rests upon the presence of the symptoms and signs which have been described, in association with the constitutional or local conditions in which functional derangements of the heart are known to occur, or the history of a direct exciting cause. The absence of the physical signs of organic heart disease, and of the rational symptoms of transference of blood-pressure from the arterial to the venous side of the circulation, must further be established.

Prognosis.—The prognosis is as a rule favorable, both as regards the separate attack and the ultimate recovery. I have not seen organic disease of the heart develop as a sequence of either frequently-recurring or long-continued functional disorder.

Treatment.—In the paroxysmal forms the treatment must be directed to the immediate condition. The child must be placed at rest in the recumbent or sitting posture, the clothing loosened, every effort made to allay fear and calm excitement. The face and hands should be bathed, and by degrees the attention diverted. If necessary, ammonia may be inhaled or a few drops of the aromatic spirit of ammonia in water administered.

In the case of syncope the recumbent posture should be maintained for some time and a current of air admitted. The face may be sprinkled with cold water, and the venous circulation in the limbs favored by centripetal frictions.

Efforts should be made to correct those conditions which act as predisposing influences. Attention to hygiene is of the first importance. Systematic feeding and a diet at once nutritious, easy of digestion, and abundant, are imperative. Fresh milk, eggs, broiled and roasted meats, bread-crusts, fresh vegetables and fruits, selected and regulated according to the age of the child, constitute the dietary. Quality is of supreme moment: variety is not necessary. A spoonful of preserves or jam occasionally should be regarded as a treat. The breakfast should be taken early, the dinner at midday, supper at five or six o'clock, and bed-time should not be later than eight. The bath should be given in the morning, cold or at most only tepid, and followed by

brisk towelling till the skin glows. By day and night the clothing must be warm, light, and loose. Exercise in the open air should be systematic and regular. Even in changeable climates delicate children, when properly clad, may go out to walk, except in extremely cold weather or in actual storms, almost every day—not only without injury, but even with positive gain.

Anæmic conditions require prompt and careful attention. Among the drugs most useful in their management are alcohol, cod-liver oil—which, in well-made emulsion, children take very well—syrup of iron iodide, and the various preparations of mercury and of arsenic in minute doses.

Lithæmia, whether inherited or acquired, demands very careful study and management. Here a milk diet is especially useful, and an occasional laxative. Where the fault lies with the nervous system, long hours of rest, especially rest in the middle of the day, and the bromides, are of advantage. Adenoid vegetations of the pharyngeal vault must, when discovered, be forthwith removed.

Wholesome moral influences and discipline at once gentle, affectionate, and firm are of untold value in the care of delicately organized and impressionable children. Those who have the care of the young ought to possess in a high degree that rare greatness which shows itself in the ruling of one's own spirit—said to be beyond that which enables one to take cities.

If disturbances of the cardiac function occur during dentition, the stomatitis which often arises must be promptly treated, and if the gum over a presenting tooth be tense, livid, and tender, it may be freely incised.

Derangements of digestion are best managed by withholding ordinary food for a time, giving small amounts of milk and lime-water, a calomel purge, and the subsequent administration of an efficient pepsin.

If intestinal worms be present, they are to be expelled by appropriate treatment.

The functional derangements of the heart which occur in acute disease and during convalescence disappear with returning health, and as a rule demand no especial treatment.

It remains to speak of the group of drugs familiarly known as heart tonics. They are rarely indicated, often used with no good effect. What the heart most needs for its best nutrition, both in childhood and afterward, is well-oxygenated, healthy blood and moderate and fairly regulated work; and these constitute the greatest need also of the nervous system, which controls and regulates the heart.

Digitalis, nux vomica, and belladonna are often required. They must, however, be given only in response to clear indications. Their employment in short courses under proper circumstances is highly beneficial; as a matter of routine they are not only generally useless, but also often hurtful.

PART X.

DISEASES OF THE GENITO-URINARY SYSTEM.

HÆMATURIA, PYURIA, CHYLURIA, ANURIA, AND INCONTINENCE OF URINE.

By E. M. BUCKINGHAM, M. D.,

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Hæmaturia.

Blood reaches the urine from any part of the urinary passages. Its quantity varies within the widest limits, and the color of the urine containing it ranges from bright red to smoky red, dark greenish-brown, or almost black. The longer it remains in contact with urine, and the more thoroughly mixed with it, the darker it becomes, especially if it be in small quantity. A very large hæmorrhage is more likely to be from the bladder, and a small one from the kidney. It has therefore been assumed that the presence of bright blood shows a vesical, and of dark blood a renal, hæmorrhage. This is not necessarily true, for in individual cases large hæmorrhages have been seen by means of the electric light to issue from the ureters, and small ones may certainly come from the bladder. If blood is fresh and in sufficient quantity to render the urine alkaline, it may settle to the bottom of the containing vessel, leaving a clear upper layer of urine. Clots occur only when the blood is in tolerably large quantities, and especially when not thoroughly mixed with urine. They may be large enough to cause pain from consequent retention, and they may decompose and give rise to cystitis. By their shape they sometimes give evidence of their place of origin, but moulds of the ureters may resemble those formed in the prostate. It is possible for urine to be discolored like that of hæmaturia without containing blood. Icteric urine has this appearance if sufficiently charged with bile, and red stains of uric acid upon the diapers are occasionally taken for blood. In hæmoglobinuria no red corpuscles are present, but the urine is nevertheless stained with blood-pigment. When urine contains any appreciable amount of blood, it also contains albumin in appreciable quantity. Blood-cells are probably found by the microscope, but they become swollen and disintegrated in very dilute or ammoniacal urine.

If the blood has its source in the urethra, its appearance is usually confined to the beginning of micturition. The cause may be traumatism, including the passage of small ragged calculi. There is a case on record of hæmaturia in a child from urethritis depending upon decomposition of urine the result of malposition of the meatus, and entirely and quickly relieved by operation. Blood from prostatitis—rare in children—precedes the urine if the seat of inflammation be in the anterior part of the gland, or it flows backward into the bladder

and mixes with urine if it comes from the posterior part. Generally the last few drops contain most of the blood. In either case micturition is frequent and painful, and is generally followed by tenesmus. Rupture of a vessel at the neck of the bladder might cause similar symptoms. If pain and frequent micturition are both absent, this region can with tolerable certainty be excluded as the source of hæmorrhage. If cystitis or pyelitis causes hæmaturia, the urine contains pus. The pain of cystitis is more likely by far to be referred to the bladder, and that of pyelitis to the back, but this distinction is not absolutely diagnostic. Both conditions are rare in childhood, but either may be excited by calculus, tubercle, or acute disease.

Calculi in any part of the urinary tract may occasion hæmaturia, and renal calculi may do this without causing other symptoms. Vesical calculi are not uncommon in children, but do not, as a rule, give rise to much bleeding. This is more likely to come from a calculus impacted in the ureter, in which case there is probably severe pain.

The symptoms of tubercular bladder resemble those of cystitis. In making this diagnosis one should eliminate the more common causes of bleeding, and examine elsewhere for tuberculosis, which is seldom if ever primary in the urinary organs. Bacilli in the urine would help the diagnosis, but they are stated by Osler to be scanty in pyelitis; and this would be expected where the tubercular surface is constantly washed with urine. Therefore, their absence would not exclude this disease.

Prolonged bleeding with intermissions very probably comes from one kidney or its pelvis, intermissions being due to plugging of the ureter. Exacerbations of pain during intermissions increase this probability. Chill or vomiting may accompany them. Generally, however, hæmorrhage starting above the bladder is not painful.

Blood from the kidney generally contains enough renal casts and epithelium to suggest its source, but one should inquire further. Bloody urine is a symptom of acute nephritis. There is generally the history of an exciting cause, and often much œdema. The urine not only contains blood, but is at first scanty and of high specific gravity, with albumin and numerous renal casts. Hyperæmia, not amounting to nephritis, also causes bleeding. The difference is one of degree. Passive hyperæmia from a weak heart may produce it. It may occur in the course of chronic parenchymatous and of interstitial nephritis, especially toward the close, but is by no means universal in them as in acute nephritis, nor are these diseases so common in childhood. Some drugs cause hyperæmia or nephritis, and therefore hæmaturia. Among them are turpentine, cantharides, potassium chlorate, carbolic acid, and amyl nitrite. Rhubarb is said to invariably cause it in certain persons.

Neoplasms occasionally cause hæmaturia, but less frequently in children, because carcinoma, which often bleeds, is rare with them, while sarcoma, which is more common, bleeds less. Villous growths in the bladder give rise to serious hæmorrhage. If in the prostatic region, there may be pain at the end of micturition, owing to the tumor being squeezed by the empty bladder. Berkeley Hill writes that we may infer that blood comes from a villous growth if bleeding is profuse at first and painless, and lasts from a few days to a week or more. It stops as suddenly as it begins, and is uninfluenced by rest or exercise. Fragments are occasionally washed out in the urine. Such growths have been removed by the écraseur, but bleeding often stops of itself. Harrison reports the removal of a small fibroid from the bladder of a boy of seventeen, giving complete relief to a hæmorrhage which recurred at intervals of two weeks. There was severe pain in the penis.

Certain parasites occasion hæmaturia. The rhabditis genitalis, as described by Scheiber, was found by A. Baginsky in the urine of a child three and a half years old with hæmoglobinuria, and by Peiper and Westphal in the urine of a feeble child of nine, who had had scarlatinal nephritis four years before. In the latter patient, pleuritis occurred in October, and in November severe hæmaturia, followed by negative urine; then for a short time there was much blood and pus in the urine. A month later a less severe hæmorrhage occurred, at the beginning of which the amount of urine was temporarily lessened. In two days the microscope detected worms, hardly half as large as trichinæ, which on comparison appeared to be the Scheiber worms. Many were found, but all were dead. None were detected in the blood, stools, or preputial secretion. Soon hæmaturia ceased, but slight albuminuria lasted six weeks, when more, but degenerated, worms were passed. Albuminuria then ceased. Meanwhile, marked improvement in enuresis of two years' standing occurred. The authors are cautious about assuming relation between these worms and this symptom.

Berkeley Hill mentions the filaria sanguinis hominis as causing hæmaturia: this sometimes occurs in chyluria, believed to be generally due to this parasite.

The Bilharzia hæmatobia, first described by Bilharz of Cairo, is found in streams in Africa from the Mediterranean to the Cape of Good Hope. The mature worm is too small to be seen by the unaided eye. Eggs have been found in various parts of the body. The view of Bilharz, that it is swallowed in unfiltered drinking-water, is commonly accepted. Allen of Pietermarizburg, South Africa, reasons from its greater frequency in boys, who bathe in rivers, and from the urethra being a favorite residence for it, that it may also enter by the meatus. He states that he can sometimes feel a colony in the upper urethra by means of a metallic catheter, and reports relief from urethral injections. Hæmorrhage occasionally causes retention from clots, and may be serious from prolonged oozing, but patients may recover after years of suffering. Davis reports that the use of kamala appeared to limit the number of embryos passed.

Malarial hæmaturia is found in many parts of the world. In the United States it is confined to severe cases, and generally to highly malarial regions. It is not uncommon in the South, but seems less frequent in cities than in the country, which apparently emphasizes the need of a high degree of malarial poisoning to produce it. Cases are reported in children as young as four years; these were of a distinct adult type, marked with severe chills and fever, rather than of the partly masked form. Castle states that malarial hæmaturia is not invariably accompanied by chill. Some cases are remittent and some pernicious. The presence of blood-pigment may be continuous, or the urine may become entirely clear between paroxysms. It may contain many blood-corpuscles or only a few with much hæmoglobin, or blood-corpuscles may be entirely absent, although the urine is colored with blood-pigment. Day states that the urine of comparatively mild cases is more likely to contain red corpuscles than that of severe ones. It has been urged that they are present at first and decompose, but there is reason to believe that they become altered in the vessels, allowing the escape of free hæmoglobin. Various theories have been advanced to account for malarial hæmoglobinuria: (*a*) the action of bile on the blood while still in the vessels, supported by the fact that injection of bile or bile acids into the blood has produced bloody urine; (*b*) the general disturbance of the spleen and liver, organs which have a part in the formation and destruction of red cells; (*c*) the effect of external cold on the stagnant blood of the extremities during paroxysms; (*d*) the direct destructive action of the

plasmodium malariæ upon the red cells. Malarial hæmoglobinuria is more or less combined with real hæmorrhage, therefore the name hæmaturia is probably the better one. It is a grave condition at best, and is probably often fatal despite every method of treatment.

Some writers of the Southern States assert that malarial hæmaturia is not due directly to malaria, but to quinine. This causes congestion in other organs, and, considering the enormous doses used in the South,[1] it possibly sometimes excites nephritis; but there is a malarial hæmaturia not due to quinine. Hæmaturia sometimes precedes any treatment. Owen has suddenly put a stop to it, together with other malarial symptoms, by the subcutaneous injection of quinine, and a series of 286 cases collected by Howell shows that those treated with quinine and calomel made the best recoveries.

There is a considerable English literature relating to cases of paroxysmal hæmaturia, in which evidence of malaria is absent or so slight as to cause doubt if it be a factor in the etiology. Herringham reports the cases of two sisters of four and a half and three and a half years; and four other cases of his were under five. These sisters were observed from November to May during several attacks. They were at first coincident with exposure to cold, but one occurred while the child was kept in bed. There was generally no albuminuria, except a trace before some paroxysms, showing that it was mostly hæmoglobin rather than blood that entered the urine. It was reported that both children had been syphilitic, and he states that Murri of Bologna believes paroxysmal hæmaturia to be syphilitic. Berkeley Hill also states that hereditary syphilis gives rise to this symptom. Verco reports the case of a man who could produce hæmaturia whenever he pleased by merely going into the cold. It was accompanied by chill and a temperature of from 101° to 103° F. There was no albuminuria in the intervals, and no periodicity. He was not known to have had malaria. Rosenbach is quoted in the *American Medical Journal* (vol. iii, p. 544) as reporting a case excited by a cold bath in summer. Other patients have paroxysms only in winter. In considering the etiology, it must be remembered that malaria once contracted may give rise to symptoms without fresh exposure, and may be irregular in its course. On the other hand, the reports from the South, where it is common, show malarial hæmaturia only when accompanied by well-marked malarial symptoms. Some cases of paroxysmal hæmaturia have lasted for long periods and have recovered.

Paroxysmal hæmaturia may result from physical exercise, being perhaps analogous to the so-called physiological albuminuria of soldiers after forced marches. Herringham also mentions mental exercise as a cause, and reports a case where it was brought on many times in an adult by worry or excitement. Lannois reports the case of a patient whose first attack was at the age of nine years, and who had not recovered at thirty-two. Paroxysms were excited by gymnastics, railroad travelling, light work, and especially by long walks. They always disappeared with rest and light diet. At first there was but little blood, and that disappeared the next day. At one time albuminuria persisted a few days. During the height of paroxysms the microscope showed red blood-cells, many leucocytes, and renal epithelium. The peculiarity of this case is its long duration. There were no malarial phenomena nor any history of malaria or syphilis, nor had the patient been in the tropics. Since childhood he had occasional pain in the side, which led Lannois to suspect some obscure disease of the kidney.

Among badly-fed children scurvy occasionally causes hæmorrhage into the

[1] I am not criticising the doses in question: no one has a right to do that without the experience in malaria that Southern physicians have.

urine as well as elsewhere. The diagnosis of scorbutic hæmaturia includes the diagnosis of scorbutus. (See article on Scurvy.) It is conceivable that hæmaturia may occur in natural bleeders, but I cannot find the report of a case within ten years.

The treatment of hæmaturia will be indicated by the exciting causal condition.

Pyuria.

Pus may enter the urine at any point. When it occurs it results from some underlying cause, but it is seldom found in the urine of children, because they seldom have the diseases that cause it. It is said, indeed, that boys may have a non-venereal urethritis from debility. Mild vulvitis and vaginitis from this cause are rather common. Cystitis and pyelitis are very occasional sequelæ of several acute diseases. They may be occasioned by the irritation of drugs and of saccharine urine. The presence of calculi is possibly the most frequent cause of this rather uncommon symptom.

Chyluria.

Chyluria is especially a disease of certain tropical and subtropical regions, but enough cases of European and North American origin have been reported, particularly in the southern parts of the United States, to prevent our considering it absolutely tropical. As it lasts a long time and does not absolutely disable the patient, it may be imported anywhere. Prout reports a case at eighteen months. Cases are either parasitic, apparently the most common, or non-parasitic. Hunt reports a traumatic case, probably due to rupture of a lymphatic in the kidney. The urine remained chylous but a short time. At first it smelt of milk, afterward of sour milk. The same and also a putrid odor have been observed in other cases. Parasitic chyluria is due to the presence of a minute parasite, the filaria sanguinis hominis, itself the product of a parent parasite, the filaria Bancrofti. The filaria sanguinis hominis probably establishes a fistula between the lymphatics and the urinary organs. It is found in the blood, but, as a rule, only in the late afternoon and night, though by changing the meal hours it may be found at other times. Although usually a parasite of warm countries, it was found by Weiss in the urine of a child who had never been out of Illinois.

Patients are not generally very ill, but chills and abnormally high or low temperatures are reported, and the disturbance to nutrition from prolonged and occasionally profuse hæmorrhage leads to debility. Attention is generally first attracted by the presence of chyle, which may merely make the urine turbid or as white as milk. Blood may precede it. The presence of urinary casts is the exception. Elephantiasis may be a complication, and chyle may exude from swellings in various parts of the body. Cases may last continuously for years or may intermit. Suzuki, by limiting diet, and especially by omitting meat and fat, decidedly lessened the chyle in the urine. Grimm found that he could regulate the amount of chyluria by regulating the fat ingested. In his case there was enough coagulation to cause pain in the bladder, but no renal colic. He therefore concludes that chyle entered the urine between the ureter and the urethra. Sigmund mentions a case in which advantage was taken of a prolapsed bladder to see clear urine issuing from the left ureter.

Anuria.

Complaint is sometimes made that the urine of a little child, generally a baby, is suppressed. This may depend on congenital malformation or an acute

renal disease, but usually it is a symptom of short duration and no danger. There is often slight fever and a history of imperfect digestion, possibly of difficult dentition. A liberal supply of drinking-water is the only treatment required.

Incontinence of Urine.

After a time, differing with the intelligence of the child and the pains taken with its education, probably also with muscular development, children learn to use the chamber-vessel. The age when this takes place averages about eighteen months, but is sometimes much later. An undetermined proportion lose control of the bladder after acquiring it; this occurs before the age of six or seven. Incontinence is not uncommon in any class of society, and patients often come incidentally under observation after suffering for a long time, the delay being due to the prevalent belief that spontaneous recovery occurs about puberty. Some patients have incontinence of fæces as well as of urine. In some this condition prevails both by day and by night, in some few by day only, but by far the most numerous class is that which has nocturnal incontinence of urine alone. Occasionally patients pass from one class into another. Among nocturnal cases urine is passed while absolutely unconscious, or the child dreams of the act and wakes to find itself wet. This happens once in the night or oftener. Temporary recoveries sometimes occur, to be followed by relapses, and incontinence is far more troublesome in winter than in summer. These considerations should make us careful about claiming results for treatment unless the patients are watched a long time, especially so if recovery occurs in the spring. Many remedies have been proposed, and papers written to show the brilliant results of one or another treatment, yet the number of cases that do not improve continues large. The failure of some practitioners where others seem to succeed is due partly to hasty generalizations at the bottom of many enthusiastic papers, partly to the after-history of patients being obtained for too short periods. But, with all allowances, a study both of the literature and of our individual patients should convince us that we are not dealing with one condition, but with a symptom common to many conditions. Unfortunately, we cannot always find this underlying cause, and with our present knowledge many patients must be treated empirically. When we do find it, we sometimes accomplish much more than can be done by blind groping.

A few cases occurring in the day-time depend on postponement of micturition owing to the demands of play, yet there are cases of day-time occurrence that are unavoidable. I have notes of the case of a lady who is never troubled at night, but who wets her under-clothing so often by day that she always wears a guard. This condition has lasted since early girlhood, and is increased by excitement. Large doses of strychnine, continued for some weeks, gave temporary relief. I do not think nocturnal cases are due to carelessness in any appreciable number. Children are generally mortified at this failing, and would be only too glad to avoid it.

Profound sleep, if not a cause, is often at least an accompaniment. This fact, first noticed by Trousseau, receives more attention from French than from English-speaking or German writers. I have often found that the one child of a family that wets its bed is also the soundest sleeper. Therefore waking the child when its parents retire for the night may be something more than a palliative, and here may be the explanation of some recoveries as patients grow older, when sleep becomes less sound than in early childhood. Recovery at puberty is more often attributed to some obscure influence of maturity on the genitals. In favor of this view it may be said that some women recover at

the time of their marriage. Whatever the reason, however, many recoveries do occur about the time of puberty.

Many patients are debilitated, and debility often, if not the only causal factor, is nevertheless one so powerful that on its removal the child recovers. A large proportion of such patients in my former dispensary service were anæmic, and recovered as soon as given enough iron. These cases were not sufficiently followed up for me to speak as to relapses; but patients, after long and varied treatment without result, do sometimes get well, and stay well, on proper attention being paid to the general health. Such attention does not, of necessity, exclude other treatment. I have notes of the case of a boy treated with belladonna, strychnine, and electricity many times during some years, but with no permanent result, he being always in poor health. When eleven years old, while at the seashore, as badly off as ever and without treatment, he learned to swim, and returned permanently relieved, and with a taste for athletics for which he had been formerly too weak. Whether such incontinence as this is caused simply by a weak sphincter, itself a part of a generally weak system, or whether by a neurotic condition due to anæmia, is a matter upon which one may speculate. Certainly, some of the subjects are neurotic. Possibly both explanations hold good—sometimes one, sometimes the other, and sometimes both together.

Nux vomica and its equivalent, strychnine, are often used successfully. They have a good effect on many neurotic people and are general tonics. They are especially indicated when we know the sphincter to be weak. This may occur if the child has been compelled to hold its water too long, as sometimes happens at school. Cold douches to the perineum are probably local in effect, and the same is true of electricity and massage. Good results are claimed for all of them. Electricity is generally used in the form of faradization, with one pole on the lumbar part of the spine and one in the urethra, the vagina, or on the perineum, the sittings lasting a few minutes each day or every other day and the current being as strong as the child will bear. I object to introducing the electric or any other sound into the child's urethra or vagina—especially in girls approaching puberty—if it can be avoided, and therefore prefer the perineum. This care, perhaps excessive, combined with a possible bad selection of cases, may partly account for my non-success with this treatment. Certainly, I in common with others have not obtained the good results claimed.

Local massage has its advocates. Some good results have been reported, but this method, like all others, has its failures. Sanger massages the sphincter by introducing a probe into the bladder and exercising gentle pressure backward and from side to side. The danger of teaching masturbation is, I think, to be considered.

There is a class of cases in which the urine is sometimes passed with great force, evidently from some other factor than a weak sphincter. There are grounds for believing many of them to be hereditary; many are neurotic. I have met in one family of three children, one case of somnambulism, two of chorea, and one of nocturnal incontinence, the last ejecting the stream violently by day. Chorea is itself supposed to be a cause. It is assumed that there is want of co-ordination between sphincter and detrusor. In other words, such cases are choreic. Such considerations lead to treatment designed to allay irritability of the bladder, by the use of belladonna, potassium bromide, and ergot. Belladonna, originally given by Trousseau in a single night dose, has since been administered in three daily doses. Baruch gave it in the late afternoon and early evening in a series of cases, thus avoiding the probably unnecessary morning dose, and better graduating that in the evening. This is of

some importance, as it is often necessary to approach a poisonous dose; that is, to get some effect on the pupil; and also because the continued use of this drug is not always innocuous. At least, I believe that I have seen gastric disturbance and general malaise result from its prolonged use. It is, however, in many cases the most efficient treatment known, and is perhaps to be preferred where we can make no probable diagnosis of the underlying cause. Relief is sometimes temporary, sometimes permanent.

Epilepsy is responsible for a certain number of cases. So is the general disturbance attending the onset of acute disease. Ergot, by lessening congestion in the spinal cord, is sometimes of use where there is a very irritable bladder.

Children whose mode of life affords frequent opportunity for micturition, make use of it, and thus accustom the bladder to contract when not very full. In such cases a dry bed can sometimes be secured by gradually training the bladder to contain greater amounts, thereby educating the sphincter. This plan must not be carried out too heroically, or a strained instead of a strengthened sphincter will result. It is said that sleeping on the back, by causing urine to press upon the most sensitive part of the bladder, is an exciting cause, and may be relieved by elevating the foot of the bed.

Urine loaded with uric acid, urates, oxalates, or phosphates may cause incontinence, as well as an irritable bladder; hence the urine should always be examined. Albuminuria is said to be a cause. I have met with diabetes in a child, where the real diagnosis would have been overlooked but for the routine examination for sugar in this affection. Possibly the effect of ptomaïnes on the brain may be to produce incontinence in some children, as it does night-terrors in others. Whatever the explanation, attention to the digestive organs is sometimes of great use.

The influence of phimosis is exaggerated. I have met with several cases in circumcised Jews, while half of Townsend's cases were in girls. Furthermore, patients have been operated on without relief. Yet phimosis is sometimes a cause. Patients previously carefully treated without result do sometimes get well immediately after circumcision or even after breaking up adhesions between prepuce and glans. Phimosis is merely one of several conditions giving rise to reflex incontinence. Among others are a small meatus, rectal polypi and fissures, pin-worms, hardened fæces, and even, in one reported case, a brass button in the nose. Masturbation is said to sometimes result in incontinence.

Davenport reports a case, and refers to another, in which malposition of the orifices of the ureters was the cause.

Among palliatives is avoidance of drinking large quantities of liquid late in the day. This must not be overdone, for a too concentrated urine may be as irritating as one too abundant. Regular habits of life seem of some use. I had opportunity to observe a boy admitted to the hospital on the day that an epidemic of measles began there. As he had been exposed, it was not thought desirable to begin treatment until he had had the disease. He had regular diet and hours with no excitement. Before the incubation period was over the incontinence had ceased. He did not contract measles, and after a reasonable time of observation was discharged.

This symptom, then, arises from the most varied causes and repays careful study of the individual. The general health is never to be lost sight of. Hopes of relief are reasonable, but it is never to be promised, and we are not justified in assuming treatment to be successful until after a long lapse of time.

DIABETES MELLITUS, DIABETES INSIPIDUS AND LITHIASIS.

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I. Diabetes Mellitus.

Diabetes Mellitus is a constitutional disease especially characterized by the secretion of an abnormally large amount of urine charged with sugar. While in adults there is good ground for admitting at least two forms of diabetes mellitus, a mild and a severe form, in children I have as yet met only the latter, of which the course is more rapid than in adults.

Etiology.—The etiology of diabetes in children is even more obscure than in adults. In both heredity is an acknowledged influence, but with this exception the cause of diabetes in children may be said to be unknown. In adults, while in the majority of cases a sufficient cause is sought in vain, there are certain well-recognized influences, such as prolonged overwork, anxiety, and grief, which favor its causation: these agencies cannot operate in children. The sex-relation of diabetes is reversed in children as compared with adults, it being more common in girls than boys.

Morbid Anatomy.—In the matter of morbid anatomy, too, we are unable to find lesions which can be held responsible for the disease. Rather are they the result of it. It is true that recent studies have shown an increasingly close relation between diabetes and pancreatic disease, originally pointed out by Lanceraux a number of years ago. Extirpation of the pancreas, according to Von Mehring, Minkowski, and Lepine, is invariably followed by diabetes if the extirpation is complete; and although De Dominicis, to whom we are indebted for the original experiment, and De Renzi and E. Reale deny this, it is still true that this operation is followed by glycosuria in a vast majority of cases, while every year furnishes autopsies in which pancreatic lesions are far more common than any other. At the same time, typical cases of diabetes are constantly occurring in which there is no pancreatic disease.

Among anatomical lesions—in addition to those of the pancreas—which are found in connection with diabetes, may be mentioned enlargement and hardening of the liver, cirrhosis, dilatation of its capillaries, amyloid changes in its cells; hyperæmia, and even slight grades of parenchymatous inflammation, of the kidney; tuberculous foci and cheesy degeneration of the lungs; and a variety of lesions of the nervous system, especially in the neighborhood of the medulla oblongata, among which tumors and traumatic lesions are the most common.

Symptoms.—In children, as in adults, a frequent desire to pass water, with increase in quantity, intense thirst, and sometimes great appetite, are the symptoms which commonly first attract attention. Examination of the urine discovers the presence of grape-sugar or glucose, and a specific gravity

usually higher than normal, 1030 and upward, although a lower specific gravity does not preclude the presence of sugar in considerable amount. Rapid emaciation, shrinking and dryness of the tissues, and constipation are early associated. If we add the peevishness and restlessness which grow out of these conditions, and occasional intense itching of the genitalia, we include most of the symptoms which occur in children. The neuralgic pains and rheumatic complications, the lung involvement so often seen in adults, are not commonly present in children. Cataract I have met in a single case, a boy of sixteen. It was double.

The state of the urine, which contains sugar and is increased, varies as it does in the adult. In a little girl four and one-third years old, under my care for some time, whose case may be considered a fair example, the quantity ranged from 65 to 200 ounces (1950 to 6000 cc.) in the twenty-four hours, and the proportion of sugar from 13 to 34 grains to the ounce (3 to 7.5 per cent.), the specific gravity 1018 to 1040. Toward the close of the disease diacetic acid and aceton are found in the urine, and death by diabetic coma is not unusual. Concurrent with the diaceturia and acetonuria are a diacetæmia and acetonæmia.

Albuminuria occurs in a certain number of cases of diabetes in children, as in adults, from two causes: first as the result of irritation of the tubular structure of the kidney by the sugar-charged urine, and second as a coincidence.

Pneumonia is prone to occur, as in adults, tuberculosis to a less degree, but gangrene I have not met in children. The suggestion that in a large number of these cases the albuminuria is due to the excessive quantity of eggs consumed in the diabetic diet I do not consider sustained by the facts.

Diagnosis.—With such a train of symptoms as those noted there should not be much delay in recognizing diabetes mellitus, even without an examination of urine. All cases, are not, however, so clear, and such examination is always necessary to a proper study of any case. The occasional confusion due to the reducing effect of uric acid on the proto-salts of copper should be borne in mind. The darker hue and scantiness of the uric-acid urines should excite suspicion, while the absence of all other symptoms of diabetes should protect against error.

The tests for sugar at once most delicate and to be relied upon are the copper tests, and of these the most satisfactory is the solution known as Fehling's.[1] In using Fehling's solution for qualitative testing take 1 cc. of the solution and dilute with four times its bulk of water; boil the mixture thus obtained, and, if it remain clear, it is fit to be used in completing the test. If, however, there should be a precipitate of the red suboxide on boiling before any urine is added, the solution is spoiled and a fresh one should be obtained. If the fluid remain clear after the first boiling, the urine should be added, drop by drop, until a bulk equal to the original mixture of Fehling's solution and water is obtained; and if no yellow or red precipitate takes place, the urine may be said to be free of glucose. It is scarcely necessary to say that the gray floccu-

[1] Fehling's solution is thus made: Dissolve 34.639 grams of pure crystallized sulphate of copper in 200 cc. of distilled water; 173 grams chemically pure crystallized neutral sodic-potassium tartrate in 480 grams of solution of caustic soda of sp. gr. 1.14; and into this basic solution pour the copper solution, a little at a time; then dilute the resulting mixture to 1 litre with distilled water. The tendency of Fehling's solution to deteriorate is well known. This may be obviated by substituting glycerin or mannite for the tartaric acid, but more effectually by dissolving the sodic-potassium tartrate in 480 grams of solution of caustic soda and diluting to 500 cc.; the copper in 500 grams of distilled water; and keeping the solutions separate until such time as they are wanted, when 1 cc. of each will furnish 2 cc. of Fehling's solution.

lent precipitate of phosphates which sometimes occur should not be mistaken for a precipitate of suboxide of copper.

A sufficiently accurate quantitative test may be made with Fehling's solution thus used if it be remembered that it is of such strength that if the cupric oxide be exactly reduced—that is, if the *color is exactly removed* by an equal bulk of urine—that particular specimen of urine contains *one-half of 1 per cent.* of sugar; if the color is removed by half of the bulk of urine, the sample contains 1 per cent.; and if twice the bulk of urine is required, the sample contains ¼ of 1 per cent.; and so on. Moreover, if, as is usually the case, it is necessary, by reason of the large percentage of sugar, to dilute the urine, the proportion should be 1 to 9 of water. Then we proceed as before, multiplying the result by 10. When it is remembered that it *is impossible to judge accurately of the progress of any case of diabetes mellitus without a quantitative analysis for glucose*, the importance of having an easy clinical quantitative method will be appreciated.

In the absence of Fehling's solution the original form of the copper test suggested by Trommer may be thus used: The urine is first alkalized by about one-fourth its bulk of liquor potassæ, and then a drop or two of a preferably weak—say 1 to 30—solution of cupric sulphate should be added. A precipitate ensues, but if sugar be present the first drop or two of the copper solution is redissolved on shaking. The addition should therefore be continued until a slight excess remains, when heat is applied, and in a few seconds a precipitate of the yellow cuprous hydroxide occurs. This subsequently loses its water and becomes the red cuprous oxide.

Of the remaining tests for sugar it will be sufficient to give the *fermentation test*, which is easy and serves a *quantitative* as well as a *qualitative* purpose, while it has fewer sources of error than any of the other tests. The objections to it are that it requires several hours for its operation, and that quantities less than a half of 1 per cent., or 2½ grains to the ounce, cannot be detected. The simplest method of its application is as follows: Having taken the specific gravity of the sample to be tested, fill a four-ounce bottle with the urine, to which add a small piece—say the size of a pea—of German yeast or a teaspoonful of brewer's yeast, after which shake thoroughly; put aside in a warm place, temperature 60° to 80° F., for at least twelve hours. At the end of this time, sugar, if present, will have been converted by fermentation into carbonic acid and alcohol, and the specific gravity proportionately lowered. For practical purposes it may be allowed, as originally ascertained by Dr. Roberts, that for every degree of reduction of specific gravity on the urinometer there is *1 grain of sugar to the fluidounce*. Thus, if the original specific gravity is 1040, and the specific gravity after fermentation 1020, there are 20 grains to the fluidounce. From this the percentage may be ascertained by multiplying such difference by .23. Thus in the illustration named the percentage would be 4.6.

The matter of the selection of a specimen of urine for analysis is of the greatest importance. It goes without saying that the most suitable sample is a portion of the whole twenty-four hours' urine collected for the purpose. But it is evident that it is often—indeed, almost always—impossible to do this. Then my practice is to take two samples for analysis—one a portion of that passed on rising in the morning, the other a portion of that first passed after the evening meal, usually that passed at bed-time. If pains be taken always to examine samples thus selected under the same conditions, comparisons may be made from day to day or week to week which suffice for clinical purposes.

Prognosis.—The prognosis is unfortunately very bad in children. The

only case of a child I have ever known to recover was a girl of twelve under the care of a friend. Life may, however, be prolonged for a time by careful attention to dietetic, hygienic, and medicinal treatment. The course is, however, always much more rapid than with adults, and the fatal termination comes sooner.

Treatment.—In children, as with adults, the most efficient treatment is the dietetic, and the greatest difficulty is that of getting a substitute for bread. Of the various so-called gluten flours and breads, so far as I know, the only ones made in this country which contain so little starch as to justify the name pure gluten or almost pure gluten are the gluten flour of Theodore Metcalf & Co., of Boston, Mass.,[1] and the No. 1 gluten biscuit and No. 1 gluten meal of the Sanitarium Food Company of Battle Creek, Mich. No new preparation of gluten should be accepted for what it claims to be unless the claim is sustained by analysis. In England and France diabetics are more fortunate, as they can secure flour, bread, and biscuits containing a minimum amount of starch. The great objection to all pure gluten preparations is that they are more unpalatable than the bread made of flour from which the starch has not been removed. But it should be made clear to the friends of the patient that he must make his choice of the two evils.

It is not always necessary that the purest attainable gluten preparations should be used in mild cases, as in these a certain amount of starch is assimilable; but such latitude must be based on trial of fixed quantities of the given breads associated with careful quantitative analyses of the urine selected as directed. To such the so-called "bran bread" made out of unbolted flour, in which the ratio of starch is of course less, and oatmeal gruel with cream, may be allowed. Unfortunately, mild cases of diabetes are not commonly found in children.

Among the substitutes for the white flour so much used is almond flour, and it is totally without objections, so far as its composition is concerned. The patient is apt to tire of it as of anything else from exclusive use, and fair digestive capacity is required.

Various other flours have been suggested. One of these is the flour of the *soya* bean (*Soya hispida*), a native of Japan, but now extensively grown in Europe, said to contain only 4 per cent. of starch. It is, moreover, very rich in nitrogenous substances. From this are made bread and biscuit. A flour known as *poluboskos* contains a small quantity of starch, and is a suitable food for most diabetics. *Fromentine* is another of these flours made from the embryos of wheat, which, so far as I know, is not yet obtainable in this country. Like the soya flour, it contains a considerable quantity of oil, which not only renders pannification difficult, but disposes to early rancidity. Efforts are also being made to isolate for the same purpose legumine, the caseine of the leguminous vegetables. The substance so isolated is known as embryonine.

[1] The following are the directions suggested by Dr. John A. Jeffries in common use for making gluten biscuit out of the Metcalf flour:

Gluten flour	1 cup.
Best bran, previously scalded	1 cup.
Baking powder	1 teaspoonful.
(Or the equivalent of bicarbonate of soda and cream tartar.)	
Salt	to taste.
Eggs	two.
Milk or water	1 cup.

Mix with a spoon.

The appended table is one which has been my guide for many years, and I believe it includes most of the articles admissible:

Food and Drink Admissible in Diabetes Mellitus.—*Shell-fish.*—Oysters, mussels, and clams, raw and cooked in any way, without the addition of flour.

Fish of all kinds, fresh or salted, including lobsters, crabs, sardines, and other fish in oil; fish-roe, caviar.

Meats of every variety except livers, including beef, mutton, chipped dried beef, tripe, ham, tongue, bacon, and sausages; also poultry and game of all kinds, with which, however, sweetened jellies and sauces should not be used.

Soups.—All made *without* flour, rice, vermicelli, or other starchy substances, or without the vegetables named below as not allowed; animal soups not thickened with flour, such as bouillon, beef-tea, and broths.

Vegetables.—Cabbage, cauliflower, Brussels sprouts, broccoli, green string beans, the green ends of asparagus, spinach, tomato, dandelion, mushrooms, lettuce, endive, coldslaw, olives, cucumbers, fresh or pickled, radishes, sorrel, young onions, water-cresses, mustard and cress, turnip tops, celery tops, artichokes, gherkins, okra, parsley, or any other green vegetables.

Fruits.—Cranberries, plums, cherries, gooseberries, red currants, strawberries, acid apples, lemons, oranges sparingly, all without sugar. Acid fruits may be stewed with the addition of bicarbonate of sodium instead of sugar.

Bread and cakes made of gluten, soya, almond flour, inulin, "poluboskos," fromentine, or embryonine, with or without eggs and butter. Griddle-cakes, pancakes, biscuit, porridges, etc., made of these flours. In cases requiring less stringency the so-called "bran bread," made of unbolted flour, the *crust* of bread, and oatmeal porridge with cream.

Eggs in any quantity, and prepared in all possible ways, without sugar or ordinary flours; butter and cheese.

Nuts.—All except chestnuts, including almonds, walnuts, Brazil nuts, hazelnuts, filberts, pecan-nuts, butternuts, cocoanuts.

Condiments.—Salt, vinegar, and pepper in moderate quantities.

Jellies.—None but those unsweetened, except by saccharin. They may be made of calf's-foot or gelatin and flavored with wine.

Drinks.—Coffee, tea, and cocoa-nibs, with milk or cream, but without sugar; also Vichy, Vals, and Carlsbad waters, carbonated waters, and all mineral waters freely; lemonade without sugar, acid wines, including claret, Bordeaux, Rhine, and still Moselle wines, diluted with Vichy or similar waters, very dry sherry; unsweetened brandy, whiskey, and gin. No malt liquors, except those ales and beers which have been long bottled and in which the sugar has largely been converted into carbonic acid and alcohol. Saccharin may be used for sweetening.

To be Especially Avoided.—Potatoes, white and sweet, rice, beets, carrots, turnips, parsnips, peas, and beans; all vegetables containing starch or sugar in any quantity; sweet wines, including sherry, Madeira, port, and champagne.

The hygienic treatment of diabetes mellitus is important. The patient should be bathed frequently, and brisk friction should succeed the bathing in order to stimulate the circulation. Out-door life and muscular exercise, short of that sufficient to excite fatigue, should be insisted upon, the idea being to stimulate every process which may result in the oxidation of sugar. For a like reason the sleeping-room should be well ventilated and the purest air supplied to it.

The medicinal treatment of diabetes is limited, as there are few drugs

having power to control the defective assimilation resulting in sugar excretion. The most efficient of these is undoubtedly opium and its preparations and alkaloids, any one of which possesses this power. Codeine is, however, the preparation usually selected, because it is less apt to produce the harmful effects of the other chief alkaloid, morphine. It is, however, much more expensive. While generally better borne than morphine, it does sometimes nauseate as well as constipate. That it controls the sugar output is abundantly proven. Moreover, I have reason to believe from my own experience that it occasionally happens that where sugar has disappeared during treatment by codeine, it does not return after discontinuance. It is desirable, however, to put off the use of opium, as a rule, until other measures and drugs fail. If the efficiency of opium in diabetes be based upon its sedative action, then the bromides should also be useful, and it does occasionally happen that they serve a good purpose; but in my experience they are of limited utility.

After opium, arsenic is perhaps the drug which has longest maintained its reputation as a remedy in diabetes mellitus, but its usefulness, like that of most drugs, is limited to the milder cases. There is no better preparation than Fowler's solution, of which the dose is so easily regulated. The action is unexplained, although a reasonable theory has recently been advanced by Cuthbertson of Chicago, who says it is partly local upon the stomach, bowels, or respiratory organs, and partly on blood-cells, increasing their activity, and therefore the oxidation of sugar. The dose must be regulated by the age, from a drop to five drops three times a day, increased until slight œdema of the face results. It is often combined with lithium carbonate, 1 to 5 grains, by which its effect is sometimes increased. The bromide of arsenic, originally recommended by Clemens, is sometimes given, but I have not found it more efficient than Fowler's solution. The preparation commonly used is Clemens's solution of bromide of arsenic, of which the dose is 2 to 5 minims, the smaller dose for children.

Ergot is a drug which is sometimes efficacious, but I value it less highly than I used to. That it sometimes exerts a controlling effect I have not the least doubt. The best form is the fluid extract in doses of five minims to a drachm.

That the coal-tar series of antipyretics, including antipyrine, antifebrin, phenacetin, and sulfonal, prominently brought forward by the French school of physicians, have in the milder forms of diabetes a controlling influence, I can also assert from my own experience. As claimed by the French school, their efficiency is increased by combinations with alkalies, sodium carbonate being commonly used in the proportion of twice the dose of the antipyretic. Thus, if 15 grains of antipyrine are given, 30 grains of sodium bicarbonate are added, and these doses are recommended by Dujardin-Beaumetz and Germain-Sée for adults. They are bulky and apt to derange the stomach, and they should not be given after meals. My method has been to give the combined drugs in equal doses before meals. For children they should be much smaller—3 to 10 grains of the drug, with an equal quantity of sodium bicarbonate. If the antipyretic is given alone, it may be given after meals, although a somewhat larger dose is then required.

Salicylate of sodium has some reputation, and may be used, especially when the diabetes is associated with rheumatism.

Alkalies alone, doubtless, have an effect in the diabetic process, and it is this constituent to which the alkaline mineral waters of Vichy, of Vals, and of Carlsbad owe their chief efficiency. None of the negative mineral waters in this country, so much vaunted by their owners as specifics, have in my expe-

rience any effect whatever. Persons visiting the sources of these waters may be benefited, but the associated diet, and not the waters, is the efficient agent.

A great many remedies have from time to time been suggested as useful in diabetes, and I have tried most of them as opportunity presented, generally with negative results. One of the most recent of these is jambul (*Syzygium jambolanum*). A careful and systematic trial by myself in three cases has resulted in signal failure. The dose given is from ten drops to a drachm.

The latest of these remedies is creasote, which I have not yet tried. It is recommended by Audibert as producing excellent results where diet did not seem in any way to influence the intensity of the glycosuria. The quantities used were: first 2, then 4, and finally 6, grains daily *for adults*. The glycosuria steadily diminished in one case in spite of the fact that the patient, despairing of any results, deliberately neglected all dietetic rules.

II. Diabetes Insipidus.

Diabetes insipidus is a nervous affection, mainly functional, characterized by the secretion of a large amount of urine of low specific gravity.

While diabetes insipidus is a much rarer disease than diabetes mellitus, it is believed to be relatively more frequent in children than the latter. Out of 70 cases collected by Roberts, 22 were under ten years of age, and 13 between ten and twenty; out of 85 by Strauss, 21 were under ten; and of 87 by Von der Heijden, 7 were under ten and 19 between ten and twenty.

Etiology.—Nervous influences, such as those which produce hysteria—viz. shock, fright—are the principal causes of diabetes insipidus. Thus a boy of ten years, recently treated by myself, was choreic at various times prior to the attack of polyuria, and was very nervous throughout the illness, from which he recovered.

Morbid Anatomy.—No definite morbid anatomy has been found associated with simple polyuria. The kidneys have been found sacculated in various degrees, more likely as a consequence of the enormous accumulation of liquid filling the bladder and pressing backward through the ureters upon the kidney structure, causing its atrophy. Tubercular and gliosarcomatous tumors in the neighborhood of the floor of the fourth ventricle have been found.

Symptoms.—The chief symptom is a profuse polyuria associated with a proportionate thirst. The quantity of urine exceeds that of all ordinary cases of diabetes mellitus. The boy of ten referred to would pass a quart at a single sitting, while the frequency of the desire to pass water made it impossible to attend school. The specific gravity is proportionately low, generally 1002 to 1006, and I have known it to be scarcely above 1000. For the twenty-four hours' urine the other constituents remain usually normal, while albuminuria is much more rare than in diabetes mellitus.

As a natural result of such a condition there is great dryness of the skin and mucous membranes. On the other hand, there is never that extreme emaciation seen in children with diabetes mellitus, and the patients are often fairly well nourished. This is favored by the fact that the appetite is apt to be increased, from which, indeed, derangements of digestion may result.

Other nervous symptoms frequently attend or precede diabetes insipidus, such as chorea, restlessness, and sleeplessness.

Diagnosis.—The diagnosis of diabetes insipidus is easy. The enormous quantity of urine passed, its low specific gravity, and the absence of sugar, if maintained for any length of time, can mean nothing else. It is barely

possible that the milder forms might be confounded with chronic interstitial nephritis in adults, but in children this seems impossible. The presence of a trace of albumin should, however, lead to an exhaustive examination of the urine for casts and other signs of interstitial nephritis—a very rare disease in children.

Prognosis.—The prognosis in my experience is generally favorable, the patient sooner or later getting well.

Treatment.—Cases under my care have usually yielded sooner or later to ergot or gallic acid, the former in beginning doses of 10 minims of the fluid extract, or less according to age, and increasing until results are obtained or full doses reached without effect. Gallic acid may be given in 5-grain doses at the beginning and increased. For antipyrine and antifebrin great efficiency in the treatment of this affection has recently been claimed. While I have as yet had no opportunity to try them, my experience with these drugs in diabetes mellitus leads me to expect that they will be even more efficient in diabetes insipidus. The same reasoning leads me to expect that bromide of potassium would be useful, as it sometimes is.

Valerian is one of the older remedies for simple polyuria, and it can be easily understood why it should be useful in nervous cases. The older physicians used powdered valerian and valerianate of zinc, but at the present day the more elegant preparation of elixir of the valerianate of ammonium, in doses of half a drachm, a drachm, or more according to age, should be substituted. The exceedingly disagreeable smell of the substance is in the way of its general use. Opium is also recommended in diabetes insipidus, but has made for itself no reputation like that it has attained in saccharine diabetes.

A blister at the nape of the neck or on the epigastrium was suggested by Roberts, and might be expected to be of service by its impression on the nervous system. The constant galvanic current would be reasonably useful from the same standpoint, and is recommended by Seidel and Kuelz, the former of whom applied daily one pole of a strong battery over the loins near the spine and the other as deeply as possible over the hypochondrium.

In the matter of drinking water a moderate restriction should be exercised in diabetes insipidus, but to cut down the amount of water largely is a cruelty unjustified by the results. The cry for water is a demand to make up a loss from the economy by the kidneys. It is an effect, and not a cause. Yet it is possible to carry drinking to excess after a habit is once acquired, and for the effect thus to become the cause. To prevent this a reasonable oversight should be exercised.

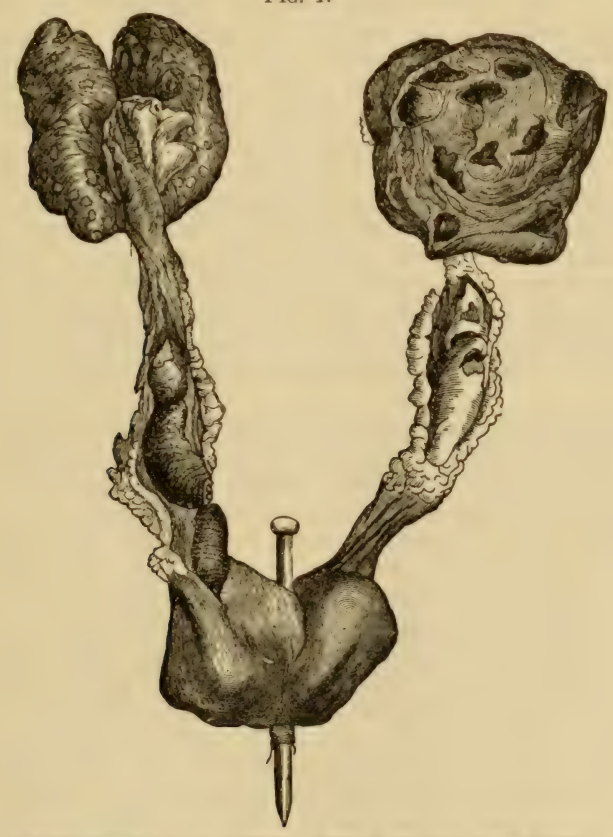
III. Lithiasis.

Lithiasis is the deposition of certain solids of the urine in the urinary tract, any portion of which, from its beginning in a Malpighian capsule to its terminal expansion, the bladder, may be the seat of such deposit. The sediments thus precipitated include, in the order of frequency, first, uric acid and its compounds of sodium, potassium, and ammonium; second, oxalate of lime; and, third, the phosphates of calcium, magnesium, and ammonium. A clot of blood or fragment of foreign matter may be the nucleus of calculi thus formed. They may be so minute as to be barely visible to the naked eye, constituting *sand* or *gravel*, or they may be a couple of inches or more in diameter, when they are spoken of in common language as *stones* in the kidney or bladder.

As stated, the most frequent sediments are uric acid, which are often found in the shape of red sand in the very first urinary discharges of the new-born

infant. Calculi may form, consisting of pure uric acid or its compounds, but they are seldom large. Less common are small stones of pure oxalate of lime. More commonly large stones consist of nuclei of uric acid or oxalate of lime, around which phosphates are deposited in concentric layers. Phosphates rarely form the nuclei of stones. The alkaline reaction of urine, which is necessary to the deposit of phosphates, is not common in children fed on milk. It is not until vegetable substances are added to the diet that the alkaline reaction becomes conspicuous. More frequently the alkalinity necessary to the precipitation of phosphates is the consequence of organic matter generated in inflammatory processes, especially those excited by calculi themselves. This occurs as soon as they reach a sufficient size to act as irritants producing local

FIG. 1.



Calculi impacted in the Ureters. From a boy of 5 years (Tyson).

inflammation. They thus become surrounded by alkaline urine, whence phosphates are deposited in concentric layers around the uric-acid or oxalate-of-lime nucleus.

It has been said that calculi may form in any part of the urinary tract. Hence they may be found imbedded in the kidney, circumscribed and encapsulated in the centre of the organ. Thus situated, they may grow by accretion until they have almost destroyed the entire organ, filling up its pelvis and calyces, converting the entire kidney into a pus-sac; or they may even make their way through the capsule of the kidney into the perinephric tissues, and thence

down into the pelvic cavity. Appended is a drawing of a remarkable specimen occurring in the practice of the writer in a boy of five years, twice successfully operated upon for stone in the bladder, the first time when but three years old. He perished finally of exhaustion. The necropsy only revealed the extent of the mischief. The stone in the left ureter was spirally spindle-shaped, and measured 5.5 cm. long and 1.5 cm. wide in the thickest part. The stone in the right ureter was 10.5 cm. long and 1 cm. through at its thickest part. The bladder also contained a small stone 2.5 cm. long and ranging in diameter from .5 to .75 cm.

Etiology.—It would scarcely be profitable to attempt to discuss the causes why in one child there is a tendency to deposit uric-acid sediment, or why in another under apparently the same conditions an oxalic-acid lithiasis should exist. The conditions which favor phosphatic deposits have been mentioned. Whatever may be the cause of each, there can be no doubt that in every case the deposit of sediments is favored by a reduction in the amount of water separated by the kidneys—a condition which depends largely on the amount of liquid ingested. The reaction of the urine, whether acid or alkaline, also plays an important rôle. Phosphatic sediments are never spontaneously deposited from an acid urine, nor uric acid from an alkaline urine. The law cannot be so sharply laid down with regard to oxalate sediments, crystals of oxalate of lime being deposited in alkaline as well as acid urines, although I believe the reaction of urine containing them is most frequently acid.

Calculi may present themselves at any age, and probably begin their formation sometimes even before birth. At any rate, large stones have been removed from the bladders of children in the first year after birth—too large, it would seem, to have been produced in the short time which had elapsed since birth.

Symptoms.—The symptoms of lithiasis in the child vary very greatly according to seat and degree. For convenience, such symptoms may be divided into those caused by sand or gravelly deposits, those caused by calculi in the bladder of such size as to justify the term "stone," and those caused by calculi impacted higher up in the urinary tract, in the pelvis of the kidney and in the ureters.

Sand or *Gravel in the Bladder.*—A simple peevishness or fretfulness or other evidence of pain in an infant, with retractions of the limbs, may be caused by gravel, evidence which is confirmed by red-pepper-like sediment on the napkin or an unusually dark staining of the latter by urine. The same condition in an older child may give rise to more intelligible manifestations of discomfort, which may be located in the lumbar region, in the groin, or in the urethra. A very common mode of manifestation of discomfort in the latter situation and in the neck of the bladder is traction upon the prepuce, which often becomes elongated in consequence. At this early age a frequent desire to pass water, and especially wetting the bed at night, should lead to examination of the urine, the presence wherein of uric-acid or oxalate-of-lime sediments would, together with dark color and high specific gravity, add further probability of the presence of such a cause.

Stone in the Bladder manifests itself by very much the same symptoms, though intensified, especially the disposition to draw upon the prepuce and frequency of micturition. Tenderness in the region of the kidney will be found where the pelvis is the seat of detention of the calculus, and not infrequently bulging, and even fluctuation from the presence of pus, may be detected. Abdominal palpation should not be neglected, as enlargements of the kidney are very apt to be anterior in direction. Examination of the urine may give negative

results, or it may show the presence of the crystals already mentioned; more frequently the secretion contains evidence of irritation of the bladder in the presence of mucus or pus, while a trace of albumin will attend the presence of pus. When mucus or pus is absent, the microscope may still discover mucus threads or so-called mucus-casts, which always mean irritation of the genito-urinary passages short of what is sufficient to produce mucus or pus in the urine. Such urines, if not already alkaline when passed, readily become so, and the alkalinity thus produced tends to make the urine viscid and glutinous. Where the alkalinity takes place in the bladder in the presence of pus, this glairy material is formed in the viscus, and micturition becomes difficult or impossible.

Such a set of symptoms will of course suggest the use of the bladder-sound, by which a stone is commonly readily recognized.

The continuance of symptoms of such severity as are caused by the larger stones soon affects the general health of the patient, as attested by feverishness and gradually growing emaciation, which may terminate in death.

Diagnosis.—This is successful according as the lines of investigation may be thorough or otherwise in the examination of urine, palpation, and the use of the sound.

Prognosis.—This is generally favorable, the use of appropriate solvent medicines and diet being sufficient to correct the states wherein only gravelly sediments are present; while the surgeon's knife even more promptly removes the stone from the bladder or kidney, nephrotomy to-day saving many lives which would have formerly been lost. It is only, for the most part, those cases which have advanced too far, or which present the peculiar conditions presented in Fig. 1, which are beyond the reach of any remedy, and gradually wear out the patient.

Treatment.—As soon as a stone of size sufficient to be recognized by a sound, or by localized pain or tenderness in the kidney itself, is discovered, there is but one course to be pursued. The case must be handed over to the surgeon. At the present day no intelligent physician expects to dissolve away a stone by medicinal treatment.

From the physician's standpoint, treatment is therefore limited to such cases in which the lithiasis is confined to gravelly sediments. Of these there can be no rational treatment except after a thorough chemical and microscopical study of the urine, and, although symptoms may be relieved without such study, the success attained is accidental, and reflects no credit on him who employs it. The management demanded by different conditions is often diametrically opposite.

If, on examination, the urine is found highly acid in reaction, depositing uric-acid sediments, the treatment is pre-eminently by alkalies. It does not much matter what alkalies are used. They should, however, be associated with an abundance of liquid, in order the better to furnish a solvent for the uric acid. The liquor potassæ of the U. S. Pharmacopœia is an excellent remedy in doses of 5 to 20 minims, the dose being adapted to the age of the patient and administered three or four times a day. The object should be to alkalize the urine, and in testing it a time of day should be selected when the urine is most likely under ordinary circumstances to be acid. Such a time is the early morning before food is taken. Milk is an admirable medium for liquor potassæ. The salts of potash are also useful, and there is less danger of an overdose. The citrate and carbonate are equally efficient in doses of 5 to 15 grains three or four times a day, or oftener if necessary to secure an alkaline reaction. With alkalinity established, uric acid cannot be precipitated. On the other hand, care must

be taken to avoid the opposite extreme—having escaped Scylla, to steer clear also of Charybdis. If the urine be made too highly alkaline, the phosphates will fall and the sediments of these urinary constituents arise. The alkaline mineral waters, of which the imported Vichy waters are the type, and even negative mineral waters, are useful in the uric-acid lithiasis.

The new substance, piperazine, is an admirable solvent for uric acid in doses of 3 to 5 grains for children.

On the other hand, if we have an alkaline urine to contend with and persistent phosphatic deposits, we must seek to make the urine acid. This, unfortunately, is not so easy. There are very few medicines which have this tendency. Benzoic acid and boric acid are the only ones, and neither of them is well borne in large doses by children. But they should be given in doses of 1 to 5 grains every three hours, or often enough to secure the acid reaction sought for.

Oxalate of lime, unfortunately, is insoluble in both acids and alkalies. At the same time, it is sometimes formed under the same conditions as uric acid. The same general plan of treatment may be carried out.

Oxalate-of-lime sediments frequently attend dyspeptic states, which are successfully treated by acids, especially nitromuriatic, which should be cautiously administered in combination with suitable doses of tincture of nux vomica, or even strychnine, with pepsin or pancreatin.

Where the composition of gravel cannot be determined, it is a great deal better to give an abundance of distilled water than the alkalies and alkaline mineral waters, by which we only add fuel to the flame if it happens that we are dealing with phosphatic gravel.

As to diet, if the gravel be uric acid, meats and albumens should be limited, as they tend to produce an acid urine and uric-acid sediments. On the other hand, milk and vegetables tend to alkalize the urine. Abundant experience has taught me that not only during childhood, but also during infancy, parents are too indifferent about giving their children pure water to drink. Children should be encouraged to drink water between meals, and infants should be given pure water to drink two or three times a day. They soon grow fond of it, and in this way liquid is furnished to flush out the excretory channels of the economy, and to dissolve the solids which can only be removed in solution.

In children, no less than in adults, pain must be relieved by appropriate anodynes. The milder preparations of opium, as paregoric, should be made to suffice, because of the danger of the stronger preparations. The suppository is a convenient and effectual medium. Phenacetin will often relieve the milder, and sometimes even quite severe, degrees of pain, especially if it be renal. Five to ten grains may be given at a dose.

ACUTE AND CHRONIC NEPHRITIS, AND AMYLOID DISEASE OF THE KIDNEY.

By I. N. DANFORTH, M. D.,

Chicago.

I. Acute Tubal Nephritis.

Synonyms.—Acute catarrhal nephritis; Acute desquamative nephritis; Acute croupous nephritis; Acute parenchymatous nephritis; and Acute Bright's disease.

Etiology.—In adult life exposure to cold and wet is the most common cause of acute tubal nephritis, but it is a curious and interesting fact that the disease is very rarely produced in children in this way. My experience quite accords with that of Ralfe, who says, "I have never yet succeeded in obtaining a history of exposure to cold and wet in a case of acute nephritis occurring in childhood." The usual causes are acute febrile diseases, especially the exanthemata; septic diseases, like diphtheria and erysipelas; and traumata, such as burns, scalds, and injuries involving the nervous centres. Certain drugs in use among children, notably cantharides and turpentine, are capable of inflaming the kidneys, and I have known the extravagant use of highly-flavored confections produce the same result.

Symptoms.—The symptoms of a well-marked case of acute nephritis are always pronounced and aggressive. The patient is sometimes seized with an initiatory chill, but if this is absent pyrexia is always present, the temperature ranging from 100° to 103°, or even 104°F., and maintaining this altitude for from six to twelve days. The pulse is frequently tense, and has a peculiarly quick, short, nervous beat, thus giving expression to the cardiac irritation characteristic of the uræmic state. The tongue is coated, the appetite lost, and the bowels constipated. There is generally deep dull pain in the lumbar region, due to the swollen condition of the kidneys. Headache is a prominent symptom, vertigo is not uncommon, transitory strabismus sometimes occurs, and if relief is not promptly obtained uræmic convulsions supervene, to be followed by partial or perhaps profound coma, with probably dilated, but certainly uncontracted, pupils. If the coma is not complete, obstinate nausea with violent retching will probably occur; that is, the vomiting of uræmia.

The urine is diminished in quantity from the first, and this significant symptom progresses until complete suppression may occur. The reaction is usually acid; the specific gravity increases from 1.025 to 1.040, in the early stage, but diminishes later; the color varies from pink to a vivid red, the intensity of the color denoting roughly the quantity of blood present, for it rarely happens that acute nephritis is not attended by well-marked hæmaturia. Albumin is always present in large quantities, at least one-quarter, and frequently three-quarters, by volume; that is, when a specimen of urine is

tested by heat and nitric acid in a test-tube and allowed to stand for twelve hours, the albumin will occupy from one-quarter to three-quarters of the space. A copious sediment will fall when the urine is set aside; this is made up of hyaline, epithelial and blood-casts, free blood-globules, many of them crenated, renal epithelium, granular urates, and amorphous matter. In the early stage blood-casts will predominate; later on, epithelial and hyaline casts are more abundant, and before convalescence is established some fatty or granular casts may appear, although they are usually few and far between, unless the case falls into a chronic condition.

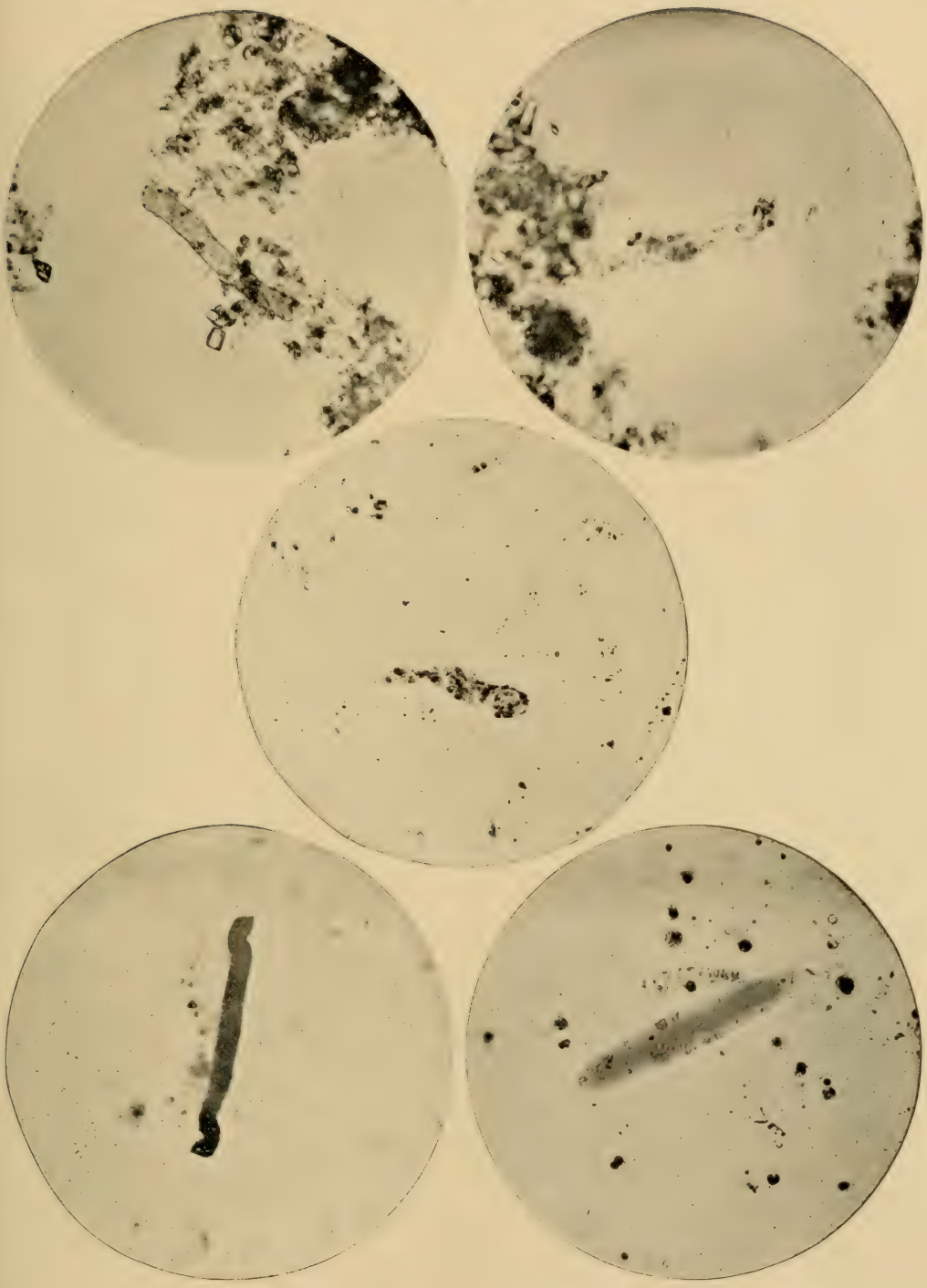
Dropsy appears very early in the case, generally manifesting itself first in the lower eyelids, cheeks, or the loose tissues of the neck; it then invades the feet and travels upward, reaching the scrotum or labiæ, then the abdominal cavity, and it may be the pleural or pericardial cavities. Œdema of the lungs may occur; the glottis may be distended with fluid, threatening or even causing death by asphyxia, although this can generally be avoided. As already intimated, the heart's action is rapid and the systole is quick, powerful, and "angry," because of uræmic irritation and increased arterial tension.

The foregoing account of symptoms relates to a well-marked typical case. Of course mild cases occur, when the symptoms are much less pronounced; but it is also true that cases of greater severity and more rapid progress are occasionally seen, which generally prove rapidly fatal from acute uræmia.

Morbid Anatomy.—The kidney is swollen, not hypertrophied, but distended with blood and also by the contents of the convoluted tubes. Dickinson relates a case in which the capsule of both kidneys was ruptured by the intense distention caused by congestion, but this is a very exceptional occurrence. The color of the kidney is much darker than normal, and the stellate veins stand out with great distinctness. If the organ be laid open lengthwise, blood will drip freely from the cut surface, and it will be seen that the cortical substance is apparently much increased. The Malpighian bodies sometimes project above the level of the incised cortex, and may be felt as little rounded bodies under the finger. Microscopic section shows the small vessels much dilated, especially those of the glomeruli; in fact, these are in many instances ruptured. The convoluted tubes are much distended by casts, blood-globules, cast-off epithelia, and granules or crystals of urinary salts, and the straight tubes are in less degree distended by similar contents. If the disease passes into the chronic stage, of course the kidney will show granular or fatty degeneration.

Diagnosis.—The diagnosis of acute nephritis can scarcely be said to present any difficulties. The rapid invasion, early occurrence of dropsical effusion, arterial tension, and especially the scantiness of the urinary secretion, together with its pink or red color, at once indicate the nature of the illness. Of course an examination of the urine will at once remove all doubts. Acute nephritis may be complicated with, or rather preceded by, chronic nephritis, but a microscopic examination of the urinary sediment will at once reveal the characteristic fatty or granular casts, which will establish the real facts in the case. Moreover, a careful inquiry into the history of the patient will result in the discovery of symptoms indicating pre-existing renal disease. Cyanotic induration of the kidneys may possibly be mistaken for acute nephritis, but a careful examination of the heart will clear up the doubt, since this disease is almost invariably associated with some obstructive lesion of the cardiac valves, especially the mitral. Careful inquiry will also develop the fact that the disease has existed for a length of time which rules acute nephritis out of the question. As cyanotic induration is not very uncommon in children,

PLATE XXI.



TUBE-CASTS AND URINARY SEDIMENTS.

FIG. 1. Hyaline Cast, Lithic-Acid Crystals, Granular Epithelia (Acute Tubal Nephritis). × 150 diameters
FIG. 2. Epithelial Cast, Lithic-Acid Crystals (Acute Tubal Nephritis). × 150 diameters.
FIG. 3. One Epithelial and Two Hyaline Casts (Chronic Interstitial Nephritis). × 150 diameters.
FIG. 4. Hyaline Cast and Renal Epithelia, stained (Chronic Interstitial Nephritis). × 150 diameters.
FIG. 5. Waxy Cast (Amyloid Degeneration). × 150 diameters.

it should always be borne in mind when renal symptoms are under investigation.

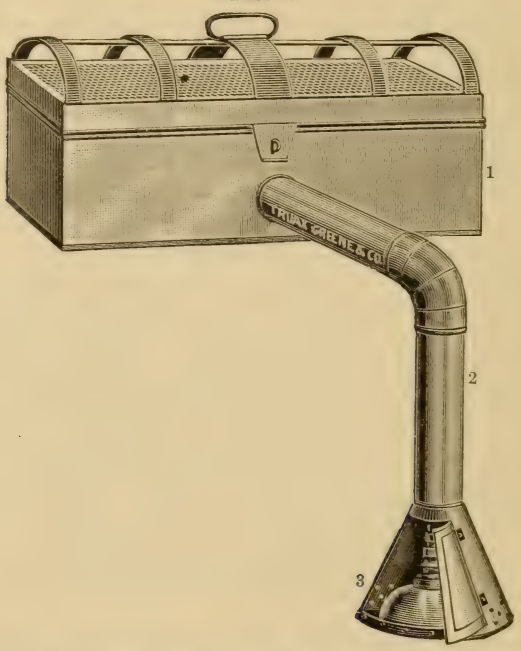
Prognosis.—Acute nephritis is always a grave disease, and is by no means free from danger. Yet, if recognized early and treated appropriately, there are few serious diseases that yield better results. Of course, I am now speaking of uncomplicated diseases. But the danger is greatly increased if the child has cardiac insufficiency, bronchitis, tuberculosis, or any other organic affection. If proper treatment be not instituted until inflammatory exudation has been poured into the tubes and capsules of Bowman, the chances of recovery are diminished, although the case is not hopeless. Suppressio urinæ and uræmic convulsions indicate a condition of extreme danger, but I have seen several perfect recoveries even after these untoward symptoms have appeared. Children are more apt to recover than adults; in fact, granted an otherwise healthy child, an early diagnosis, and prompt and vigorous treatment, the great majority of cases will recover without damage to the kidneys.

Treatment.—Promptitude without precipitation and vigor without rashness should guide the physician in the treatment of acute nephritis. It is frequently the case that a judicious blow at the right time saves a life, and, on the other hand, it is equally true that hesitation and delay cost the life or blight the future of many a child. If the child be strong and vigorous and the attack be violent, it will be wise to apply three or four leeches over each kidney, or, if the leeches cannot be obtained, blood should be taken by means of cups. The amount must of course depend on the age and strength of the child, but two ounces would be none too much to take from each renal region if the child be from six to eight years of age and in vigorous health at the time of the attack. Immediately following the bleeding a large hot linseed cataplasm should be applied, so as to entirely encircle the body at the level of the kidneys. If the poultices be covered with rubber cloth or oiled silk, they need not be changed oftener than every six hours. It is very important that they be made to "fit" the body closely, and if a little powdered mustard be incorporated in each poultice, it will be an improvement. But no stimulating applications, like turpentine stupes, should be employed in the early stage of the disease.

The practitioner should next turn his attention to the all-important necessity for securing elimination of the urinary factors by other agents than the kidneys. Fortunately, the alimentary tract and the skin afford ample means for accomplishing this. A vigorous cathartic should be given, and I am much in favor of administering from one to three grains of calomel, and following it in three or four hours with an appropriate dose of solution of citrate of magnesium. The bowels should be kept loose for several days or until the danger from the acute invasion has passed; and this for two reasons: first, for the purpose of compelling the bowels to take up a portion of the work of the kidneys, so that the latter may have the benefit of a season of physiological rest; secondly, for the purpose of using the vast alimentary area as a "derivative" surface. Cathartics produce more or less hyperæmia of the intestinal mucous membrane, and if the circulatory current is "determined" toward the intestine, it is proportionally drawn away from the engorged kidneys—a result that is very desirable. I have many times seen the good results of this practice, and am therefore confident that it is something more than a mere theory. Of course the most useful cathartics are those which produce free watery evacuations. The skin is also a vast eliminating organ, and the reciprocal relations existing between the skin and kidneys are well known to physiologists. The physician should take full advantage of this fact in the treatment of acute nephritis, and

encourage copious as well as constant diaphoresis. For this purpose jaborandi, or its alkaloid pilocarpine, and the hot-air or vapor bath are both prompt, efficient, and certain. I have seen such excellent results from the use of hot dry air that I do not hesitate to urge its employment in every severe case of acute nephritis. My method is as follows: The patient, all but his head, is placed in a "tent" (made by supporting the bed-clothes upon arches or semicircles of half-hoops or bent wire) and the bed-clothes are drawn closely about the neck, so as to exclude cold air and include hot air; the perforated tin box (1) is then placed under the bed-clothes by the side of the patient

Fig. 1.



Apparatus for the Administration of the Hot-air Bath. The top and inner side of the box are made of perforated tin.

and about six inches away from him; a current of hot air from a spirit lamp (3) is now conducted into the perforated tin box (which acts as a "register" or "radiator") through the tin pipe (2), as shown in the figure. The result is usually very copious diaphoresis, which may be maintained for many successive hours, or even days in cases of emergency. In one case which seemed well-nigh hopeless, the hot-air apparatus was kept in action almost constantly for ten days, and the patient made a perfect recovery. In some cases the hot dry air evokes sensations of "faintness" or "smothering;" when this happens the heat should be increased very slowly, so as not to alarm or excite the patient. Now and then a case will be encountered which will not bear dry heat at all, while moist heat will be tolerated with both comfort and benefit. A few heated bricks, wrapped in wet cloths and placed around the patient under the tent, will produce active diaphoresis. This method, however, is less efficient than dry heat, and the latter will almost invariably be tolerated after a few trials.

In jaborandi we have a most powerful and certain diaphoretic, and one which is entirely safe if used at the proper time and place. In practice the

alkaloid pilocarpine, the active principle of jaborandi, will be found the most convenient and efficient and by far the easiest of administration. In cases of unusual danger, where copious or excessive diaphoresis is imperatively necessary, pilocarpine in connection with the hot-air bath is invaluable. But a proportionally larger dose must be given to a child than to an adult. To a child of seven or eight years one-eighth of a grain of the nitrate of pilocarpine will be a medium dose, and if copious sweating does not commence in half an hour the dose should be repeated. It may be given either by the mouth or hypodermatically, although in an urgent case the latter method should be adopted, and it is always preferable. In a given case experience will soon determine what dose should be employed. When bronchial catarrh is present, pilocarpine is said to have produced profuse and even fatal transudation of fluid into the bronchial tubes, so that patients have been "drowned" in their own secretions. I have seen no such results, and I believe the danger of this accident has been overestimated; but where any considerable pulmonary or bronchial lesion exists I place the patient in the hot-air bath ten or fifteen minutes before giving the pilocarpine, so that the flow of blood shall be predetermined toward the surface of the body. Three very desirable results follow the use of pilocarpine in acute nephritis: namely, the reduction of arterial tension, the reduction of the temperature, and the free elimination of urea by the skin, as shown by its enormous increase over the normal amount in the perspiration (Bartholow). In cases of danger, where dropsical effusions threaten the heart or lungs, or where uræmic symptoms are imminent, or where progressive coma indicates transudation into the intracranial cavities, the hot-air pilocarpine sweat should be repeated daily, or even twice in the twenty-four hours, until the immediate peril is averted. Here and there a case will be encountered in which the hot-water bath—placing the patient in the bath-tub with the water at the temperature of 95° to 105° F.—will answer best, because both the dry air and steam are equally repugnant. When this is the case, by all means let the hot bath be employed, but let it also be remembered that the hot dry air is therapeutically the most efficient, because it produces the most copious diaphoresis; the steam-bath is next best, while the hot-water bath possesses the least eliminative power.

It would be a waste of time to discuss the older and now wellnigh obsolete diaphoretics in view of the certainty which follows the use of those already mentioned.

While the above methods of treatment are being pushed, certain internal remedies may be used as adjuncts for the purpose of lowering temperature, lessening arterial tension, calming nervous excitement, and unloading the kidneys of the products of exudation and waste. These various indications may be met by such remedies as aconite, codeine, or the bromides, and the potassic salts, especially the acetate or citrate, or the acetate of sodium. I frequently prescribe some such mixture as the following:

℞. Tr. aconit. . . . . fʒss.
Codeine . . . . . gr. ij.
Potass. citrat. . . . . ʒiij.
Glycerini . . . . . fʒij.
Aquæ cinnamom. . . . . q. s. ad fʒviij.—M.
Sig. A dessertspoonful every two hours in half a glass of pure water.

This formula is intended for a child of seven or eight years of age; of course the quantities must be increased or diminished according to age. In some

cases it will be found that the codeine provokes nausea; when this happens, sodium bromide or potassium bromide may be substituted. In other cases the potassic citrate will cause gastric eructations or troublesome flatulency; this will call for the use of potassic acetate or sodium acetate in its place. The above formula is given simply as a suggestion; it must be varied so as to suit the indications as they arise. The practitioner should first have a clear and definite comprehension of what he wishes to accomplish; then, and then only, can he set about an intelligent adaptation of means to ends.

If the foregoing measures are promptly and vigorously carried out, it is not probable that uræmic convulsions will supervene: but if they do, the physician must be prepared to act, as it were, by instinct. He must *act*, and deliberate afterward. Place the child immediately in a bath at the temperature of 100° F.: administer chloroform by pouring 10 to 20 drops upon a napkin and holding it very *near*, but not in *contact with*, the nose until the spasms are controlled; if the child be vigorous, healthy, and plethoric, apply a couple of leeches to each temple, and allow the bites to bleed until the temporal arteries soften and cease throbbing; administer 5 to 10 grains of sodium bromide every hour till its effect is manifested: give a brisk cathartic—and I know none better than a full dose (say 5 grains) of calomel; after the convulsions cease remove the child from the hot bath to the hot-air tent (as before described), and administer hypodermatically $\frac{1}{8}$ grain of pilocarpine.

It will be of very little use to administer diuretics at this time, as the kidneys are not at all likely to respond under such circumstances, but it will be entirely in order to administer 10 grains of the acetate or citrate of potassium every two hours, dissolved in a liberal quantity of water.

It will generally be found, however, that the renal congestion will be so much relieved by the action of the cathartic and diaphoretic that the kidneys will resume their functions spontaneously. For several days after a uræmic convulsion, or until the kidneys resume their action, the child should be carefully watched, should be kept in bed, and given a milk diet, and the action of the diaphoretics and cathartics should be kept up in a moderate degree. While uræmic convulsions in children seem frightfully dangerous, it is nevertheless true that in most cases the danger is more apparent than real, and recoveries are by no means unusual.

The treatment above given is that which is adapted to the first stage of acute nephritis only. It is now incumbent upon us to consider what should be done after the violence of the first attack is past and convalescence has fairly commenced.

The problem before us is to restore to their structural integrity kidneys which have been intensely congested, which have suffered laceration of many of their minute blood-vessels, whose glomeruli and tubules have been invaded by copious fibrinous exudation, which is still taking place, although in a comparatively slight degree.

In all cases of albuminuria with scantiness of urine the temptation to administer diuretics is very great, and yet in the great majority of cases no more unwise measure could be adopted. It is always true that stimulating or irritating diuretics should be carefully avoided unless some very imperative demand for their employment exists. In fact, diuretics bear the same relation to inflammation of the kidneys that cathartics do to inflammation of the alimentary canal. A mild aperient for a specific purpose may be proper in a case of enteritis: so, under similar conditions, a mild diuretic may be proper in a case of nephritis: but in neither case can the remedy be regarded as curative of the lesion. In nephritis, as we have seen, the renal tubes become occluded

by fibrinous casts, and experience has demonstrated that these casts are soluble in the alkaline salts of potassium. It is therefore advisable to administer 10 grains of the citrate of potassium, dissolved in half a glass of water or lemonade, every three hours, it being well known that citric acid and the citrates are converted into alkalies after ingestion. If there be any serious indication of cardiac exhaustion, digitalis may be combined with the potassium, but not unless it is clearly indicated. I am persuaded that the indiscriminate and ill-judged use of digitalis and other cardiac tonics is productive of more harm than good. It should be remembered that digitalis and other cardiac tonics are not direct but indirect diuretics, acting by virtue of their power of increasing arterial tension. But the potassic salts are "direct" diuretics; that is, they actually increase elimination of the factors of the urine, especially urea, the most important of them all. Thus they subserve two useful purposes: they remove from the occluded tubes the plugs of fibrin and other material, and they rouse the dormant epithelia of the convoluted tubes into action without unduly exciting them. The vegetable potassic compounds, more particularly the citrate or acetate, may very properly be continued in medium doses until the albumin has disappeared from the urine.

One of the constant results of nephritis is anæmia, frequently of a very pronounced type. This is due to loss of blood, loss of albumin, but perhaps quite as much to the body waste which attends pyrexia and the cessation of assimilating power. No acute disease produces such rapid and extreme anæmia as acute nephritis. It is important that it be recognized *early*, before the anæmic or "run-away" heart is developed, which is so prone to result in valvular disease and a life of suffering. The remedies are rest in the recumbent position, appropriate food (of which I shall speak presently), and the chalybeate tonics. Of the latter, the "mistura ferri et ammonii acetatis" (otherwise known as "Basham's mixture") or the ferri et potassii tartras, or the ferrum dialysatum have given me the best results, and I have mentioned them in the order of their comparative value. Basham's mixture is an elegant diuretic tonic, usually very well borne and easily assimilated. It can be given as soon as the temperature falls to the normal point, and thus the practitioner can anticipate and prevent the extreme anæmia so sure to follow if the case be allowed to drift on. When the urine is scanty and the sediment abundant, it is an excellent plan to combine equal parts of a saturated solution of potassium citrate with Basham's mixture, of which a teaspoonful every three hours may be given to a child eight years old. A very good formula is the following:

℞. Sol. potassii citratis (sat.), ...
Mist. ferri et ammonii acetatis . . . . *āā* f℥j.
Glycerini . . . . . f℥j.
Aquæ . . . . . q. s. ad f℥iv.—M.
Sig. A dessertspoonful every three hours in water.

I am much in the habit of adding glycerin to diuretic formulæ, because it seems in some unexplained manner to promote their action. At a later period, when the kidneys no longer require any specific medication and a stronger tonic is desirable, the potassic tartrate of iron may be substituted in doses of from 3 to 5 grains three times a day. No other therapeutic measures will be required unless special complications arise: if this be the case, they must be met according to the indications in each particular instance.

The diet of a child suffering from acute nephritis, or, in fact, *any* lesion inducing renal inadequacy, is of the utmost importance. Both theory and

experience concur in the necessity for excluding a nitrogenous dietary. In the early stage of acute nephritis all solid food should be cut off. This exclusion should extend also to broth, beef-tea, soups, and all forms of liquid diet of which beef or mutton forms the basis. The ideal food is milk, and during the period of invasion this should be taken sparingly. Milk and water (half and half) is an excellent combination, as it combines nutrition with a natural diuretic. As the kidneys regain their activity and fever subsides pure milk may be given, together with bread, oatmeal, or crackers. A little fruit, as a baked apple or the juice of an orange, may also be allowed, but the diet should be increased slowly and cautiously, and flesh food must be prohibited until the casts and albumin have been absent for several consecutive weeks, and even then it should be given only in small quantities once a day.

A few general suggestions may not be improper. The patient—be he child or adult—should not be discharged as "cured," but should be kept under observation long after all signs and symptoms of trouble have disappeared. If frequent examinations of the urine are kept up, as they should be, the practitioner will be surprised every now and then to find a little albumin and a few small structureless hyaline casts appearing, even after they have been absent for many weeks. So long as this is the case there is great danger of a sudden return of the acute symptoms with a fatal result, or of the supervention of chronic nephritis, with equally sad, although less sudden, consequences. It is therefore the duty of the physician to warn parents of the lurking perils, and to exercise a personal supervision over the patient until health is fully restored.

Again, muscular exercise is dangerous to a patient recovering from acute nephritis, because it strains the heart and loads the urine with nitrogenous products of disassimilation, thus throwing work upon the kidneys which they cannot safely do. The patient should therefore be kept quiet for a much longer time than seems necessary to parents and friends. Lastly, the patient should be warmly clad and carefully guarded from exposure to wet and cold. Woollen garments and confinement within doors should be insisted upon until the child's symptoms and the weather give concurrent testimony that gentle exercise in the open air may be cautiously entered upon. To some these suggestions may seem superfluous, but to observe them will do no harm, while if they are neglected the lives of helpless children may pay the fearful penalty.

II. Chronic Tubal Nephritis.

Synonyms.—Chronic diffuse nephritis; Chronic catarrhal nephritis; Chronic croupous nephritis; Chronic parenchymatous nephritis; and Chronic Bright's disease.

Etiology.—Acute nephritis is the most common cause of chronic nephritis in children. Scarlatina stands next in order; then comes exposure to cold and wet, especially when combined with malarious or other unhealthful surroundings, as is so frequent among the children of the neglected poor. Long-continued suppuration, although more likely to produce amyloid degeneration of the kidneys, may cause chronic tubal nephritis, probably, as Bartels suggests, because "something is developed in these collections of pus which is taken up into the blood by absorption and excreted by the kidneys, and which, during its excretion, excites an inflammation of these excretory organs." Nearly twenty years have elapsed since these words were written, and we do not yet know what that "something" is, but in the light of modern pathological research we can easily understand that the toxic derivatives of chronic suppuration might easily worry the kidneys into chronic inflammation.

Diphtheria must certainly be regarded as a cause of chronic as well as of acute nephritis, and so must measles, but less frequently. Few cases of diabetes mellitus terminate without the supervention of chronic tubal nephritis. Finally, anything which demands constant overwork of the kidneys, or which results in a slight but long-continued irritation of them, may prove the groundwork of chronic tubal nephritis.

Symptoms.—The symptoms vary very much in different cases, being modified by the rapidity with which the disease progresses. When the progress is rapid the symptoms are more pronounced, and *vice versa*. In a typical case of chronic tubal nephritis the first symptom attracting attention is likely to be great debility and well-marked anæmia. The pulse is small, rapid, and feeble, and anæmic cardiac murmurs are common. There will probably be no rise of temperature, or, if any, very slight and inconstant. The digestion is impaired, the tongue coated, and the bowels torpid or loose and irregular. Following these symptoms, and frequently coincident with them, is dropsy, generally first manifested on the dorsum of the foot and around the ankle-joints, or perhaps it is first seen in the swollen and transparent eyelid. There is also a marked pallor or waxy appearance of the face, which is quite characteristic. The dropsy extends up the lower extremities, invades the abdomen, may reach the chest and oppress the lungs and heart, so as to become a source of serious danger, although this can generally be avoided.

The disease is usually divided into three stages; this division, though somewhat arbitrary, is convenient. During the first stage the urine is generally scanty, dark, and turbid; of variable, but with a tendency to high, specific gravity (1020 to 1025), and heavily loaded with albumin (2 grams or more to the litre), as determined by Esbach's "albuminometer"—the best, because the simplest, apparatus yet devised for the practical quantitative estimation of albumin. After standing, the urine deposits an abundant precipitate composed of hyaline and epithelial casts, with occasionally a blood-cast, renal epithelia, and granular matter of indeterminate origin. Chemical examination will show the percentage of urea to be much less than normal, while the chlorides, sulphates, and phosphates, though diminished somewhat, are nearer the normal point.

With the development of the second stage the urine increases in quantity, but becomes pale in color, sometimes all but colorless, of low specific gravity (1005 to 1010), less turbid, but not quite clear, and the sediment diminishes very much in quantity, and also becomes nearly colorless. But the quantity of albumin remains large, rarely falling below $1\frac{1}{2}$ grams to the litre, and the solid excreta are still markedly deficient. The casts also change. The blood-casts disappear entirely; the hyaline casts increase in number, and many of them are large and somewhat distorted, showing that they are formed in tubes which have shed their epithelium. The epithelial casts present a granular cloudy appearance, and their borders are eroded or "nibbled," showing that fatty change has commenced in the epithelia and that the walls of the tubes have become roughened and irregular. As the disease progresses an occasional wave of renal hyperæmia may occur, when the urine again becomes scanty, dark, and cloudy, and the casts characteristic of the first stage reappear, but intermingled with these will be found the granular casts which belong to the second stage, so that no serious confusion as to the diagnosis need occur.

With the commencement of the third stage the urine again becomes scanty and cloudy, but is still pale and watery. The albumin does not diminish, but is more likely to increase. The casts now become "fatty;" that is, they are large, short, irregular, with rough borders, and contain fine fatty granules, minute drops of fat, and epithelial cells in an advanced state of fatty degenera-

tion. During this stage periods of partial or incomplete suppression of urine are apt to occur, followed by uræmic convulsions, succeeded by coma, or perhaps sudden death without coma; or drowsiness may gradually steal over the patient, until it becomes coma ending in death. Meantime the dropsy becomes general, the limbs swell almost to bursting, the abdomen becomes distended with fluid, the thoracic cavity gradually fills, pulmonary œdema with impeded respiration occurs; the heart labors violently until it suddenly fails from exhaustion, and death ensues. It must not, however, be inferred that all cases present these distressing symptoms. In the majority they are either not witnessed at all or are easily anticipated and prevented.

Diagnosis.—Chronic tubal nephritis may be confounded with (*a*) chronic interstitial nephritis; (*b*) amyloid disease of the kidney; (*c*) cyanotic induration of the kidney.

(*a*) Chronic interstitial nephritis is very rare in children, but it is not difficult to differentiate it from tubal nephritis. Chronic interstitial nephritis (renal cirrhosis) is characterized by its slow and insidious development; by the increased volume of urine; by its low specific gravity and small amount of albumin; by the absence of dropsy, except in the last stage; by the early development of cardio-vascular tension; and, generally, by well-marked lithæmia. None of these symptoms are present in chronic tubal nephritis.

(*b*) Amyloid disease of the kidney is most likely to occur in children, and, as it sometimes occurs in connection with tubal nephritis, a certain diagnosis may be impossible. The distinctive features of amyloid disease are an increased quantity of urine with a comparatively large amount of albumin; absence of leucocytes and epithelial cells, but the presence of numerous small hyaline casts which are perfectly structureless, but some of which are likely to give the characteristic reaction with iodine. There is usually considerable disturbance of the digestive tract, with hypertrophy of the liver and spleen, and this disease is almost always caused by and associated with syphilis, tuberculosis, or some chronic disease involving suppuration. These diagnostic points are quite sufficient to distinguish an uncomplicated case of chronic tubal nephritis from an uncomplicated case of amyloid disease.

(*c*) Cyanotic induration of the kidneys only occurs where there is some obstructive lesion of the organs of circulation which retards the movement of blood through the kidneys and produces venous stasis. There is little albumin in the urine; the casts are few, generally small, and of the hyaline variety; dropsy is generally limited to the lower extremities; respiration is difficult; much exercise is impossible; and the circulation is much embarrassed. None of these peculiar features belong to chronic tubal nephritis. But careful attention to the history and constructive symptoms of the latter almost invariably enables the practitioner to arrive at a correct diagnosis.

Morbid Anatomy.—In a given case the morbid appearances will depend entirely upon the stage at which the examination is made. I shall briefly describe the macroscopic and microscopic changes which are peculiar to each of the three stages, which are themselves founded upon the anatomical changes so uniformly present.

During the first or hyperæmic stage the kidney is either of normal size or only slightly enlarged; the capsule is somewhat cloudy, but strips off easily, leaving the surface of the kidney smooth and red or purple. On section blood oozes from the cut vessels, and the cortex is seen to be relatively increased. The vessels in the "boundary layer" are turgid and frequently tortuous, and the vasa recta stand out as well-defined red lines running toward or into the apices of the cones. Between the straight vessels numerous white or grayish

lines will be seen; these are the straight tubes occluded and distended by casts and epithelia. Microscopic study of a section of the cortex will show that the blood-vessels are dilated and tortuous—that the convoluted tubes are stuffed with fibrinous casts, perhaps blood-globules, and enlarged epithelial cells, some of which are in a state of "cloudy swelling."

The second or hypertrophic stage results in considerable, and sometimes extreme, enlargement of the kidney; the capsule is but little changed and strips off easily, leaving the surface generally smooth, but with here and there a slight cicatrix-like depression. Its color is variable and mottled, showing pale grayish or whitish spots or islands surrounded by interlacing groups of "stellate" vessels, which are beautifully displayed. The pale spaces are the distended fatty convoluted tubes lying near the surface. On laying the kidney open longitudinally it will be seen that the cortex is increased, but pale or yellowish, and that it is anæmic rather than hyperæmic. The Malpighian bodies are not enlarged and prominent as in the stage of hyperæmia. The vessels in the boundary-layer are thickened and enlarged, but not distended with blood. The cones or pyramids have undergone no essential change. This is the so-called "large white kidney" or "large fatty kidney." The microscope shows the convoluted tubes distended with epithelia in an advanced state of fatty degeneration; they also contain granular casts and fine fatty granules which have not fused into drops. The Malpighian bodies are somewhat enlarged, and the space between the glomerulus and the capsule of Bowman is apt to be occupied by exuviated epithelial cells in a state of fatty transformation. The walls of the blood-vessels may be somewhat thickened, but not markedly so. It will be seen that the "hypertrophy" is more apparent than real, and that it is mainly due to the distention of the tubuli contorti, each one of which occupies far more space than it does normally. The connective tissue is not materially increased.

The third or last stage is very appropriately known as the stage of "atrophy." The kidney is small, shrivelled, mottled, but the predominant color is gray or grayish yellow. *It is never red.* The capsule is generally slightly thickened, but strips off easily, except that here and there it may bring a small bit of the kidney with it. The surface of the organ is no longer smooth, but broken by alternating elevations and depressions. On section it is seen that the cortex is wasted or atrophied, while the medullary portion is not materially changed. The cut surface is frequently oily to the touch, and if it be scraped with a scalpel, drops of oil will appear upon the blade. Microscopic sections show many of the tubules shrivelled and wasted—many others distended with fatty casts, free fat-drops, and epithelial cells in complete fatty degeneration. The walls of the blood-vessels are much thickened, and the connective tissue is somewhat increased, but has not entered upon the contractile process which produces cirrhosis. It should also be observed that the kidney is pale throughout its entire extent, which fact differentiates it from the "cirrhotic kidney," to be considered presently.

Prognosis.—During the first or inflammatory stage recoveries are common. They ought to be more so. An early and correct diagnosis and an appropriate line of treatment, administered with some faith in its efficacy, are indispensable to the successful treatment of chronic nephritis. Unfortunately, the impression is quite too general among the profession that chronic Bright's disease is always incurable, and impressions ingrained for years are apt to become dogmas. Nevertheless, chronic tubal nephritis, at any time up to the actual development of the second or degenerative stage, is a curable disease, and especially so in children, in whom the constructive forces are at their best.

After the development of the second stage, or that of pseudo-hypertrophy, the prognosis is far less favorable, yet not absolutely hopeless. I have seen recoveries take place when all the symptoms indicated the inception of fatty changes in the kidney. Each day's delay renders the prognosis less hopeful, and as the hyaline casts diminish and the fatty casts increase in numbers the prognosis increases in gravity.

With the development of the third stage, or that of atrophic wasting, all hope of recovery ends. As functional organs the kidneys are now practically destroyed. Distressing symptoms may be relieved and life may be prolonged, but that is all. Yet the physician must be sure of his diagnosis before he abandons hope, and in the practice of medicine it is far better to err on the optimistic than on the pessimistic side. The disappearance of hyaline casts or their very infrequent appearance, the prevalence of large irregular fatty casts, which are short, broken, and loaded with fatty epithelium and fat-drops, together with progressive diminution in quantity of the urine, are the most reliable diagnostic factors.

Treatment.—The treatment of every case of chronic nephritis should stand by itself, and should be carried out in accordance with a well-digested plan founded upon an accurate determination of the stage of the disease.

During the first stage, where the condition of the kidneys is something similar to that in acute nephritis, the chief object is to place the inflamed organs at rest. The patient should therefore be kept as quiet as possible and carefully guarded from exposure to cold. The bowels should be kept freely open by means of saline cathartics. The skin must be actively stimulated and made to do vicarious duty by means of hot air and pilocarpine. The kidneys should be relieved of tube-casts and other obstructive material by the use of the potash salts, much as indicated in the article on Acute Tubal Nephritis. In fact, the general indications are practically the same, and the same measures should be employed, only less vigorously. The diet should be the same—namely, milk in some form with a little fruit—and the patient should be urged or tempted to drink water freely. A little fish, a bit of broiled quail, or a chicken's wing may occasionally be allowed for the purpose of varying the monotony, but grills and roasts must be forbidden. The child should be kept warm and the inner garments should be of wool. I particularly insist on woollen stockings—a point that will surely be neglected by mothers and nurses unless insisted upon by the medical adviser. As the case progresses toward recovery chalybeate tonics are indicated, and I advise the employment of those already mentioned in the article on Acute Nephritis, to which reference may be had for details.

During convalescence the patient should be carefully watched, and it must not be forgotten that convalescence is not perfect recovery. Albuminuria will disappear slowly, and will reappear after long intervals of absence, thus showing that the renal vessels have not yet recovered their tonus; the heart will remain irritable and weak for a long period; and the hæmogenetic power of the little patient will be recovered slowly. Hence careful but not ostentatious or over-officious watching will be required for several months after all symptoms have disappeared.

When the disease becomes chronic, as indicated by the symptoms denoting "fatty kidney," the treatment will be somewhat different. The kidneys must now be relieved as much as possible by bringing the skin and intestinal tract into play. Minute doses of pilocarpine—$\frac{1}{40}$ of a grain for a child of six or eight years—may be given four times a day. A warm salt-and-water bath three times a week, followed by smart friction, is a very useful adjunct to the

pilocarpine, the bath of course being given in a warm room. If the skin is rough and dry, it is a very good plan to rub the child with fresh and well-warmed olive or sweet almond oil after each salt bath. These measures may be continued indefinitely.

Cathartics must be employed frequently, but wisely. Violent catharsis is rarely required; gentle stimulation of the bowels is frequently needed, and is very useful, both for its derivative and its eliminant effect. The saline cathartics are most useful, but an occasional cholagogue, like the following, will not be amiss:

℞. Resin. podophylli . . . . . gr. j.
Hydrarg. chlorid. mit. . . . . gr. x.
Sodii bicarbonatis . . . . . gr. xxx.—M.
Ft. chart. No. X.
Sig. One powder to be given every third night.

Diuretics should be used sparingly, and not with any expectation of "curative results." The acetate or citrate of potassium, and the bitartrate in the form of "imperial drink" [U. S. P.], are the safest and most efficient. They should be given freely diluted. Cardiac tonics will doubtless be required as the case progresses, but they should be reserved until they are actually needed, as their premature employment exhausts the heart-muscle unnecessarily. Of the various heart tonics, digitalis and strophanthus are the most reliable. The chalybeate tonics will be indicated, and the mixture of the acetate of iron and ammonia, the potassio-tartrate of iron, and the newer preparation called "ferrum dialysatum," have my preference in the order written. Special symptoms will require attention. Dropsy, if excessive, demands active diuretics, as squill, apocynum cannabinum, or that excellent preparation, "Trousseau's diuretic wine," which consists of—

Junip. contus., ʒx; Pulv. digitalis, ʒij; Pulv. scillæ, ʒj; Vini Xerici, Oj; macerate for four days, and add potass. acetatis, ʒiij; express and filter. Dose, one teaspoonful in water every three hours for a child of six or eight years, (Tyson's *Bright's Disease and Diabetes*).

Hydragogue cathartics and active diaphoresis must be employed in conjunction with the diuretics; among the former, calomel and jalap, concentrated solutions of salines, and elaterium are the best, in about one-third the dose of an adult for a child from six to eight years old. As to diaphoretics, the hot-air apparatus (see page 986), with pilocarpine, stands first always; but the hot bath or warm pack, aided by pilocarpine, may be employed for the want of something better. It may be found necessary to make minute punctures through the skin of the ankle or dorsum of the foot, so that the dropsical fluid may drain away. I prefer the point of a sharp tenotomy blade for this purpose. If uræmic symptoms appear, they must be treated as already indicated. Uræmic asthma is likely to arise; it may be temporarily relieved by nitrite of amyl, spirits of chloroform, elixir of valerianate of ammonium, or any other antispasmodic at hand, but it is a consequence of uræmia and calls for increased elimination. Insomnia may be relieved by sulphonal, chloral, somnal, or any of the newer hypnotics. I am accustomed to giving paregoric to children with chronic Bright's disease who are kept awake by distressing symptoms, and with the happiest effects, although the practice is not in strict accordance with therapeutic orthodoxy.

III. Amyloid Disease of the Kidney.

Synonyms.—Waxy kidney: Lardaceous disease: Depurative disease.

Etiology.—The most common causes of amyloid kidney are syphilis: exhaustive and long-continued suppuration, especially if associated with necrosis of the vertebræ, as in Pott's disease, or of disease of the large joints, as in coxalgia; phthisis pulmonalis: chronic ulcerative disease of the bowels; and chronic albuminuria. As some of these affections are not uncommon in children, it follows that they are liable to amyloid disease of the kidney. The most perfect or complete specimen that I have ever seen occurred in a girl of ten years, who was fairly worn out with repeated abscesses due to Pott's disease. Amyloid disease rarely occurs in a child under five years, for the reason that the above-named causes rarely exist prior to that age; yet Dickinson cites a case of amyloid spleen in a boy two and a half years old who had an exhausting abscess of the thigh.

Pathological Anatomy.—In the early stage the kidneys are about normal in size and present little change except to the experienced observer, who will note a peculiar paleness, together with a translucent appearance, when thin sections are held between the eye and a strong light. The capsule is non-adherent. When the kidney is laid open no essential change in the relative proportion of cortex and medulla is seen, but all parts appear pale and comparatively bloodless. If a few drops of an iodine test-solution be applied, multitudes of mahogany red or reddish-brown points will appear, thus locating the infiltrated Malpighian bodies.

At a more advanced stage the kidneys are enlarged, sometimes considerably, though not to an extreme degree, unless amyloid disease and chronic tubal nephritis coexist. The pale waxy or bacony appearance will now be very apparent, and the iodine reaction will extend to the convoluted tubes, the vessels of the labyrinth, and the vasa recta.

In the last stage the kidney is atrophied, contracted, and deformed. The capsule is thickened and adherent, the cortex is wasted, and one is reminded of the cirrhotic kidney, except that the latter is red or brownish red, while the one under discussion still preserves its pale waxy appearance. Microscopic sections show the glomeruli, the capillaries of the labyrinth, the vasa recta, and most of the tubules infiltrated with the characteristic waxy material. The application of the iodine test-solution[1] enables the observer to accurately differentiate the infiltrated from the normal structure.

Prognosis.—As a clinical fact, amyloid disease is incurable. In a given case, if the cause can be effectually and permanently removed before the kidneys are damaged beyond the power of carrying on their functions, life may be prolonged indefinitely. Moreover, if the patient be a child of six or eight years, subsequent growth and development may practically restore the structure and function of the diseased organs. So much for theory. In practice we generally find that the cause cannot be removed: that the liver is almost sure to be infiltrated with amyloid deposit to quite as great an extent as the kidneys; and that in most cases the spleen suffers as well. In other words, we are taught that, under certain conditions, amyloid disease is curable, but in practice these fortunate conditions are hardly ever met with; hence the disease is scarcely ever cured.

[1] I recommend the following formula:

℞. Iodi . . . . . gr. iij.
Potassii iodidi . . . . . gr. vj.
Glycerini . . . . . f℥j.
Aquæ dest. . . . . ad f℥j.—M.

Treatment.—Obviously the most important thing is the discovery and removal of the cause. As I have already said, if this can be accomplished, the progress of the disease may be arrested and the patient may live out his days. In clinical experience this can rarely be done. The next best thing is to reduce suppuration to the minimum, and secure free drainage and asepsis for suppurating cavities; to remove dead bone if it exists, and encourage the process of repair if possible; to adopt the most approved treatment for tuberculosis if present, including change of climate when it is necessary and practicable; to institute antisyphilitic treatment when indicated; and, in fine, to search out and remove the cause if possible. We possess no specific agents for the cure of amyloid disease. The iodides—especially of iron and potassium—have been highly recommended and much employed, but I have never seen any positive results follow their use. Theoretically, I should expect more from arsenic or the chloride of gold and sodium. Diuretics must be given if symptoms of suppression show themselves. Diarrhœa, which is likely to be troublesome, must be treated on general principles. Anæmia—always pronounced in amyloid disease—should be combated by iron, malt, cod-liver oil, arsenic, and especially by a liberal diet, which may be safely given unless nephritis should complicate matters. If dropsy becomes troublesome, the diaphoretics, diuretics, and cathartics already recommended will answer every purpose. Uræmia is not likely to occur, as the functional power of the kidney is destroyed so slowly that the system acquires "toleration;" but if it occurs it must be treated promptly and vigorously as already indicated. If nephritis arises, it will require the prompt employment of the measures recommended in a previous article; it is of course a dangerous complication and one of not very infrequent occurrence. Other complications may arise, just as they may in the course of any other chronic disease, and must be met and treated according to the indications presented in each individual case; but the physician should remember that the eliminating power of the kidneys is more or less damaged, and he must exercise due care in the use of certain drugs, like digitalis, which have a cumulative tendency.

IV. Chronic Interstitial Nephritis.

Synonyms.—Renal cirrhosis; Gouty kidney; Granular degeneration; Contracted kidney; Renal sclerosis, etc.

Etiology.—Among the most frequent causes of interstitial nephritis are rheumatism and gout (more correctly called lithæmia), alcoholism, lead-poisoning, valvular disease of the heart, malaria, mental strain, heredity, and chronic lesions of the genito-urinary tract. As these causes are hardly ever active in childhood, it follows that cirrhotic kidney is exceedingly rare under puberty. All authors to whose writings I have access agree that it is not a disease of childhood. I have never seen a case in a patient under thirty. Bartels records one case at eighteen years, and Dickinson one "between eleven and twenty years." Suppurative interstitial nephritis, pyelo-nephritis, or "surgical kidney," may occur in children, but it does not fall within the scope of this work. It is of course possible that heredity or cardiac disease may cause contracted kidney in childhood, but in clinical experience we rarely meet with such cases.

Symptoms.—The following are the four classic symptoms of interstitial nephritis, and I may mention them in the order of their occurrence: (1) increased arterial tension, with a sharply accentuated second sound of the heart: the increased arterial tension is easily recognized by examining the pulse; (2) the

small amount of albumin present (rarely more than 1 to 2 per cent. by volume) or its entire absence for considerable periods of time; (3) the small number of casts, their small size and structureless or hyaline appearance, and their form, which is in many instances twisted or distorted; (4) the appearance of albuminuric retinitis, which is a late and very characteristic symptom.

These four symptoms are so nearly always present in interstitial nephritis, and so uniformly absent in other forms of renal disease, that they may be regarded as pathognomonic. Early in this disease the urine is pale and watery, increased in quantity, and of low specific gravity (1005 to 1010).

Pathological Anatomy.—Chronic interstitial nephritis results in the production of the "small red," "contracted," or "cirrhotic" kidney. The kidneys are contracted, atrophied, rough or nodulated, and dark red or brownish red. The capsule is thickened, and when pulled off tears away portions of the kidney with it. On section it is observed that the cortex is very much wasted, and the medulla somewhat so. The arteries are enlarged, tortuous, prominent, and unyielding or inelastic. The organ is indurated and condensed. Microscopic sections show a great increase of the connective tissue, with wasting and distortion of the tubules and the smaller blood-vessels. Broad bands of connective tissue will be seen between the remaining tubules and surrounding the Malpighian bodies. Many minute cysts will be seen which are due to dilatations of the tubuli mainly, but partly to dilated Malpighian bodies.

Prognosis.—Chronic interstitial nephritis is incurable. The damage done by overgrowth of connective tissue cannot be repaired. Yet it is quite possible to arrest the further increase thereof, and thus practically arrest the disease and prolong life indefinitely. Much depends upon the patient's habits, environment, temperament, age, and social condition. Under favorable circumstances so much can be accomplished that, so far as the patient is concerned, a practical cure may be expected. But the physician must not forget the inveterate tendency of connective tissue toward mischief when once aroused, and he must regard the disease, although latent, as still present and ready to break forth at any unusual provocation.

Treatment.—I reaffirm and refer to all that I have said in the foregoing pages regarding habits, dress, exercise, and food and drink, except that the dietary may include a little fish or fowl or a small allowance of almost any kind of game once a day. Medical treatment should be directed to the arrest of the further development of pathological connective tissue in the kidney. For this purpose the remedies most efficient in my experience are bichloride of mercury, iodide of potassium, and chloride of gold and sodium, in small doses long continued. I use but one of these remedies at a time, but alternate them at intervals of two or three weeks. If the kidneys falter, diuretics are indicated, and I have found the lactate of strontium a prompt and efficient diuretic in this form of Bright's disease. It may be given in doses of 5 grains three times a day to patients from six to eight years old. Diuretine sometimes answers very well, but is quite likely to fail altogether. Of course the potash salts may be given with every expectation of good results. Chalybeate tonics are indicated in most cases, and the tincture of the chloride of iron is particularly adapted to our wants. If combined with syrup of lemon (℞. Tr. ferri chloridi, f℥j; syr. limonis, ad f℥ij.—M.) it makes a very palatable mixture, and will be readily taken by children. Heart failure, uræmia, and other complicating symptoms must be met and treated as already indicated in the foregoing articles.

TUMORS AND OTHER ENLARGEMENTS OF THE KIDNEY.

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Tumors of the kidney are met with in infancy and childhood with sufficient frequency to make the subject one of great importance from a clinical point of view. In the allotted space the different varieties of these tumors, or those diseases of the kidney which may constitute tumor, will of necessity be considered somewhat briefly. But, while no extended discussion of the subject can be attempted, the effort will be made to present as compactly as possible the essential facts.

In addition to solid growths—neoplasms—certain other affections, cysts, hydronephrosis, pyonephrosis, and perinephritic abscess, may give rise to enlargement in the renal region. These will be first taken up.

Renal Cysts.

Congenital Cystic Degeneration of the Kidney.

This condition may cause tumors of considerable dimensions. It sometimes results in destroying the life of the fœtus or in premature birth, and so great may be the size of the tumor that delivery is impossible and embryotomy is required. In less-marked cases the child may live a few months or even a year or two, and may not give evidence of the affection by the presence of tumor, but sooner or later is likely to perish either from uræmia or from exhaustion. In this disease the kidney is studded with or changed into a conglomeration of cysts of varying sizes, filled with a fluid usually clear, but sometimes turbid, and containing urea and urinary salts. Both kidneys are, as a rule, affected.

The condition is generally accompanied by defects of development of the urinary apparatus, such as absence of the pelvis of the kidney or the ureter, exstrophy of the bladder, and malformations of the genitalia, as well as vices of comformation of the extremities, hare-lip, cleft palate, etc. The origin of the affection has been explained by Virchow as due to an imperforate condition of the straight tubes of the papillæ, resulting from a prenatal inflammation caused by impaction of the ducts with uric acid and the urates, and leading to retention of secreted urine and dilatation of the uriniferous tubules. Another view of the etiology has been taken by Köster, who considers the condition to be due to defective development. The accompanying abnormalities of the urinary organs, as well as of other parts of the body, would seem to favor this theory, at least in some cases.

Cystic degeneration is not likely to call for surgical treatment. Even

though there should be marked symptoms caused by the dimensions of the tumor, the strong probability of both kidneys being affected and the fatal tendency of the disease would interdict any radical interference, and even aspiration could offer but slight temporary relief, if any at all.

Paranephric Cyst.

Another variety of renal cysts which may be met with in children is one which grows in the cellulo-adipose tissue surrounding the kidney, the cyst not being primarily connected with the kidney. Morris, in his work on *Surgical Diseases of the Kidney*, mentions an interesting case of this kind reported by Mr. Cæsar Hawkins, observed in a boy six years old. In this instance the cyst developed from an imperfect third kidney, and reached great proportions, extending from the lower border of the thorax to Poupart's ligament. The cyst seemed to be like the simple renal cysts met with in adults, and was filled with a clear fluid which contained neither albumin nor urinary salts.

Paranephric cysts may be of congenital origin, as in the case just referred to, and sometimes they may be due to traumatism. They may communicate secondarily, by a fistulous tract, with the pelvis of the kidney or the ureter. The diagnosis of the tumor from other forms of renal cyst and from hydronephrosis must be difficult, if not sometimes impossible.

Treatment.—These cysts should be evacuated with the aspirator, and the procedure repeated if the fluid should reaccumulate. If, after this has been tried, the cyst should rapidly fill up again, it would be better to cut down upon it and incise it, securing it to the margins of the wound in the integument, thus maintaining drainage.

Hydatid Cysts of the Kidney.

The ova of the tænia echinococcus, a diminutive species of tapeworm infesting some of the lower animals, notably dogs, sheep, and swine, are sometimes transmitted to man in food and drinking water, and give rise to what are known as hydatid cysts. In the kidney hydatids are not so frequent as in the liver, the statistics of Davaine, quoted by Roberts, showing the proportion to be 1 to about $5\frac{1}{2}$.

Pathology and Symptoms.—Hydatid of the kidney may be met with at any age, although less often in children than in adults, and is unilateral, involving the left oftener than the right kidney. Palpable tumor is produced in somewhat less than one-half of the cases. The cyst, surrounded by a capsule of fibrous tissue and having in its interior the characteristic daughter cysts, usually develops in the parenchyma of the kidney, but sometimes between the organ and its capsule, and, as it grows, encroaches on the kidney tissue, causing more or less atrophy. Sometimes several hydatids are found in the same kidney. These cysts tend to rupture and discharge their contents, and this may take place into the pelvis of the kidney, which is the usual place, into the intestine, or into the lung. The peritoneum is generally pushed forward by the tumor, and rupture into its cavity never occurs.

Unless the cyst has attained proportions sufficient to constitute a tumor, or unless it should rupture and discharge its contents in the urine, there may be no evidence of its presence. The tumor generally occupies the loin, is globular in outline, and more or less fluctuating. The thrill or fremitus supposed to be peculiar to hydatids is a very uncertain symptom of the disease in the kidney, having seldom been observed in recorded cases. Rupture of the cyst into the

pelvis or ureter is manifested by pain in the lumbar region, together with a sensation of something having given way. Then, as the vesicles descend through the ureter, symptoms similar to those caused by the passage of a renal calculus will be provoked. The vesicles may become impacted and obstruct the ureter, giving rise to distention of the kidney with urine; or, reaching the bladder and escaping into the urethra, they may obstruct that channel and cause retention of urine. The escape of the hydatid vesicles, or of portions of the laminated cyst-wall, or of the peculiar hooklets of the echinococcus in the urine positively establishes the presence of the affection. In some cases pus has been noticed in the urine during the discharge of the cyst. After once evacuating itself the tumor may subside, or, on the other hand, it may fill again and empty itself as before, and this may happen at greater or less intervals for a long time, even many years. Should the cyst undergo suppuration, fever and other evidences of constitutional disturbance will result.

Diagnosis.—A renal tumor is easily recognized as an hydatid cyst when vesicles, particles of cyst-wall, or hooklets appear in the urine. In the absence of this evidence the tumor may readily be mistaken for hydronephrosis, other varieties of renal cyst, or pyonephrosis. Hydatids differ from malignant tumors of the kidney in their slow development and the absence of constant pain and cachexia.

Prognosis.—The disposition of these cysts to rupture and discharge their contents by the urinary channels or to disappear without evacuation makes the prognosis usually good. If, however, the tumor continues to increase in size, it may lead to serious, sometimes fatal, results from destruction of the parenchyma of the kidney or from pressure upon other organs. Suppuration, either in or about the cyst, is a grave complication, and death may follow rupture into the pleural cavity or the bronchi.

Treatment.—With the object of destroying the life of the parasite certain anthelmintics, such as oil of turpentine, male fern, and the like, have been exhibited, but there is no evidence of their efficiency. When hydatids are discharged in the urine, alkaline diluents should be freely given for the purpose of increasing the secretion of urine, and thereby favoring the washing out of the pelvis and ureters. Beraud is mentioned by Roberts as having had a case in which the administration of nitre caused an increase in the discharge of vesicles. Renal colic induced by the escape of hydatids into the pelvis and ureter should be treated as when due to other causes.

If the cyst does not discharge, but continues to increase, or if it should suppurate, or if, from obstruction of the ureter, sudden distention of the kidney should occur, surgical interference will be called for. Under these circumstances, while aspiration may afford relief, the best prospect of success is offered by cutting down to the tumor, opening the cyst, and suturing its edges to the external wound.

Hydronephrosis.

The term "hydronephrosis" signifies dilatation of the kidney and the ureter from some hindrance to the outflow of urine. The affection may be either unilateral or bilateral. Its causes may be divided into congenital and acquired. When the cause is congenital, it does not necessarily follow that the hydronephrosis is present at birth; it may not develop for some years later. In extreme cases the condition has caused dystochia, necessitating embryotomy.

Etiology and Pathology.—The obstacle which leads to the formation of hydronephrosis may be any one of several. Thus an excessive angulation of

the junction of the ureter with the pelvis of the kidney, a twisting contraction, imperforate condition, or valvulation of the ureter, compression of that duct by an abnormal supernumerary renal artery, and obstruction of the urethra by a septum of mucous membrane, are all recognized causes, falling under the congenital class. As acquired causes may be named obstruction of ureter from injury due to the passage of a calculus or from traumatism from without, stone in the bladder, vesical tumors, stricture of the urethra, phimosis, and habitual frequent micturition. Floating or movable kidneys are sometimes hydronephrotic.

The proportion of cases in which there is tumor is small, but the distention sometimes reaches enormous dimensions. The appearance of the sac varies, sometimes being quite thin and pellucid, while at others it is thick and opaque. The accumulation of urine first distends the pelvis of the kidney; then the calyces becomes dilated, and by degrees the resulting compression causes absorption of the renal substance, until none, or but a mere trace, of it remains. The tumor thus formed is a cyst, sometimes, but not always, subdivided by fibrous septa. Its contents differ in the majority of instances from normal urine. Often a fluid resembling water is found; in other instances it may be brownish; and, again, colloid material may fill the sac. The fluid may contain no salt but chloride of sodium; or uric acid and its salts, oxalate of lime, and the phosphates may be present, as may albumin, pus, muco-pus, and epithelial cells in some cases.

Symptoms.—When the affection is limited to one kidney, and the sac so small as not to produce tumor, it may give rise to no definite symptom; on the other hand, occasionally there may be lumbar pain, thirst, frequent micturition, or intermittent anuria. When both kidneys are hydronephrotic, uræmia may result. When tumor is present, it is situated in the first place in the loin or flank; later it becomes more prominent in the abdomen, and may even reach such a size as to extend from the median line in front to the vertebral column behind, and from the hypochondriac region above to the iliac region below. A very large tumor will by its presence create considerable pain, and in those cases in which the trouble results from an obstruction in itself painful there will naturally be much suffering. The tumor on percussion is dull, and on palpation is soft and fluctuating, and sometimes a lobulated condition of its outline may be noticed. The abdominal viscera may be variably displaced according to the size as well as the direction in which the cyst extends, and symptoms referable to its pressure on the different organs or the diaphragm may result. Sudden subsidence of the tumor, either complete or partial, may occur synchronously with the passage of a large amount of urine. The urine under these circumstances is of a lower specific gravity than normal, and may occasionally contain pus, muco-pus, or even blood. Hydronephrosis is sometimes intermittent.

Diagnosis.—In the few cases in which the abdominal tumor subsides during the discharge of a large quantity of urine the diagnosis presents little difficulty. Under other circumstances hydronephrosis may resemble renal, ovarian, hepatic, or splenic cysts, pyonephrosis, perinephritic abscess, and ascites. There may be considerable difficulty in making the diagnosis from renal cysts, except in the case of hydatids, when vesicles appear in the urine. Ovarian cysts may be distinguished by their relation to the colon, which is generally behind them, and by the absence of dulness on percussion of the loin. In ascites the area of flatness on percussion changes on alteration of the patient's position, while in hydronephrosis it remains fixed. Pyonephrosis and perinephric abscess present a history of pyuria or the constitutional signs of sup-

puration, and œdema and redness of the integument of the lumbar region not characteristic of this affection. Hepatic and splenic cysts are affected by the movements of respiration rather more than the hydronephrotic enlargement, and tend to become prominent anteriorly rather than toward the loin.

Prognosis.—When the condition is unilateral, and the other kidney is equal to carrying the burden of sufficient urinary excretion, there is no immediate risk of life. Even if the cyst be large the prognosis is not unfavorable if it be evacuated early. But if the tumor increase to a great extent, fatal consequences may result from its pressure upon other organs, from rupture into the peritoneal cavity, or from uræmia. In bilateral cases death will sooner or later be caused by the diminution of kidney tissue induced by pressure of the accumulated fluid.

Treatment.—When there is no trouble from the size of the tumor hydronephrosis requires no treatment. Massage is sometimes recommended with the idea of removing the cause of obstruction, but if practised the danger of rupturing the cyst should be borne in mind. Large tumors, accompanied by much pain or by urgent pressure symptoms, call for evacuation of the fluid, which is most easily accomplished by aspiration. This may be repeated if the sac fills again. In inserting the trocar a spot should be chosen where there is no risk of wounding the peritoneum, for if this should happen the escape of some of the cyst fluid into the peritoneal cavity would be attended with great danger. If after repeated aspirations the sac refills, lumbar nephrotomy should be performed. The cyst, having been exposed and emptied, should be secured to the margins of the wound, and after exploring with a probe for calculus in the pelvis or ureter a large drainage-tube should be inserted. The after-treatment consists in antiseptic irrigation of the cyst, for which purpose either boric-acid solution or Thiersch's fluid may be used. If a persistent fistula should follow this operation, and if it be known that the amount of renal tissue remaining is insignificant, nephrectomy is to be recommended.

Pyonephrosis.

Distention of the kidney with pus or with urine and pus is called pyonephrosis.

Etiology and Pathology.—The condition may originate from any of the causes which give rise to hydronephrosis, provided that pyelitis be developed. Also it may result from injury, from tuberculosis, or from diphtheria and other zymotic diseases.

Distention of the pelvis and calyces and wasting of the renal parenchyma from pressure occur just as in hydronephrosis, and the kidney is eventually replaced by a mere lobulated pouch. The tumor is whitish in color, with walls of variable thickness, and the sac-contents are purulent urine or pus mixed with blood and, in some cases, phosphatic material. The mucous membrane of the pelvis is pale in color and much thickened. A large pyonephrotic kidney causes displacement of other organs, and, especially if due to impacted stone, may ulcerate, discharging its contents into one of the hollow abdominal organs or into the peritoneal cavity, or, becoming adherent to the abdominal wall, it may discharge externally, establishing a fistula.

Symptoms.—While in some cases there may be no perceptible swelling, pyonephrosis usually gives rise to a fluctuating or elastic tumor in the renal region. It is generally accompanied by pain, the character of which depends on the cause of the obstruction. Sometimes it is very severe. It originates in the lumbar region, and is increased by pressure from in front, but relieved

by pressure in the loin. Chills, fever, sweating, diarrhœa, and vomiting are present, together with marked loss of flesh. In cases in which the obstruction is not complete the urine voided, although containing pus, may be normal in reaction, being mixed with that secreted by the sound kidney; later it is liable to become alkaline. When the obstruction is complete, pyuria will not be observed. In pyonephrosis resulting from stone there will be a history of pyuria and hæmaturia extending over a considerable period.

Diagnosis.—Pyonephrosis may be confused with the same conditions as hydronephrosis. The constitutional symptoms which, on the one hand, establish the diagnosis from hydronephrosis, on the other hand render the affection liable to be mistaken for perinephritic abscess.

Prognosis.—The prognosis is more grave than in hydronephrosis, and is manifestly more serious if the condition be bilateral than when only one kidney is affected. The nature of the cause of the pyonephrosis, and whether the accumulation has been gradual or sudden, materially influence the chances of life. If it has been gradual, the opposite kidney may become hypertrophied and do duty for the diseased one. Spontaneous removal of an obstructing calculus is a favorable occurrence, as is the discharge of the cyst into some part of the urinary organs below the seat of obstruction. A fatal termination may be reached by the sac rupturing into the peritoneum, from the results of pressure upon other organs, from pyæmia, septicæmia, or amyloid disease induced by prolonged suppuration, even though the pyonephrosis has discharged its contents externally or into the intestines.

Treatment.—In cases where the obstruction is not complete the treatment may be expectant. The patient should be kept at rest with warm applications to the abdomen and lumbar region. The condition of the digestive organs should be carefully seen to, and light, easily-assimilable nourishment given. When obstruction is complete and the tumor rapidly increases in size, causing marked pain, and the constitutional effects of the suppuration are severe, or symptoms consequent upon pressure become urgent, interference is indicated and lumbar nephrotomy should be performed. When the cyst has been opened a finger should be inserted, not only to explore for a stone, but to feel for and to break down any septa which may subdivide the sac, so that all parts of it may be well drained. The cyst should be drawn up into the wound and sutured to its edges, a drainage-tube left in, and the cavity washed out daily with antiseptic fluids, as in hydronephrosis.

In cases where the kidney tissue is ascertained to be destroyed, or where the health is seriously impaired, or where prolonged suppuration continues in spite of thorough drainage, nephrectomy should be the operation selected.

Perinephritic Abscess.

Perinephritic abscess, resulting from inflammation of the fatty and areolar tissue surrounding the kidney, may be met with at any age from the earliest weeks of infancy.

Etiology and Pathology.—Perinephritis may be either a primary or a secondary condition. Primarily, it may arise from traumatism, exposure to cold, or as a sequela to the zymotic diseases; secondarily, it may result from renal calculus, pyelitis, pyelo-nephritis (or "surgical kidney," so called), pyonephrosis, cysts, tumors, and tubercular disease of the kidney, vesical calculus, stricture of the urethra, and phimosis. Again, the suppuration may be traced to disease of the vertebræ, to abscess resulting from perforative ulceration of the colon or ileum, or to retrocæcal abscess. In some instances, accord-

ing to Steven, infection from inflammation originating in the bladder may extend by means of the lymphatics of the ureter to the capsule of the kidney and the tissue surrounding it, the kidney itself escaping. In the same way it is possible that the source of the inflammation might be traced to other remote points.

When suppuration occurs the abscess is generally at first limited by a well-defined wall of lymph, but the nature of the tissue, like that in the ischio-rectal fossa, is such as to favor extension of the suppurative process, and the pus soon works its way in various directions through the loose cellular and fatty tissue. From its original situation it may burrow through the lumbar muscles and point in the loin, or it may travel downward and appear in the thigh, like a psoas abscess, or, getting beneath the pelvic fascia and passing through the sacro-sciatic notch, it may point in the buttock. Extending upward, the pus may pass through the diaphragm and cause pleurisy, empyema, pneumonia, or may discharge into the bronchi. Again, the abscess may rupture into the peritoneum, the colon, small intestine, stomach, bladder, or prostatic urethra.

In the primary cases the kidney may be found macerated or broken down by the action of the surrounding pus, while in secondary cases of renal origin there will be found the special morbid conditions to which the abscess is due.

Symptoms.—The patient will usually first complain of pain in the lumbar region, extending forward, generally severe, and aggravated by motion as well as by pressure. At the same time it will be observed that the trunk is bent toward the affected side, and the thigh is kept slightly flexed upon the abdomen and rotated outward. On assuming the erect posture the patient assists in supporting his weight by bearing with his hand upon the thigh of the affected side. Examination will reveal more or less fulness or prominence of the loin instead of the normal concavity, and in marked cases palpation and percussion will map out a well-defined tumor. This latter symptom may not be present for any great length of time in consequence of the tendency of the pus to burrow. The integument of the part is œdematous, waxy, red or congested, and hot to the touch.

The constitutional symptoms are prominent, consisting of decided elevation of temperature, reaching as high, perhaps, as 104° F., chills, sweating, anorexia, and diarrhœa. Pressure of the abscess upon the lumbar plexus of nerves excites pain in its various branches, which, together with the attitude assumed, may lead to error in diagnosis. The urine, except in those cases in which the abscess is the result of violence, and in which there may be hæmaturia or pyuria, presents no especial characteristics. In some primary cases there may be a little albumin, resulting from high temperature, or, when the abscess is large and produces congestion of the kidney from pressure, some blood may be found.

Diagnosis.—The local and constitutional signs of a fully-developed perinephritic abscess are generally sufficiently clear to leave little room for doubt as to the diagnosis. It may, however, be confused with hydronephrosis, pyonephrosis, cysts and tumors of the kidney, lumbago, disease of the vertebræ, coxalgia, psoas abscess, and perityphlitic abscess. It is not possible here to point out the distinguishing features of these affections. Careful and exact examination, together with the accurate history of the case in question, will usually easily remove any difficulty that may be in the way of establishing the diagnosis.

Prognosis.—The prognosis depends upon the cause of the abscess, although the condition should always be regarded as a serious one. When the abscess

results from pyonephrosis or from disease of some other organ, the outlook is more grave than when it is primary. The prognosis is most favorable when the pus is evacuated early, while in unrelieved cases a fatal termination is to be apprehended from the discharge of the pus into other organs—into the peritoneum, the pleural cavity, lungs, or bronchi. Amyloid disease is imminent when the suppuration is long continued.

Treatment.—At the onset attempts may be made to induce resolution of the perinephritis, for which purpose cupping or leeching of the loin and the application of an ice poultice may be tried. The patient should be kept upon a liquid diet, a simple fever mixture should be prescribed, the bowels kept freely opened, and opium given for the relief of pain. If these measures fail to ameliorate the local and constitutional symptoms, warm flaxseed poultices should be applied, quinine added to the medicinal treatment, and the patient closely watched. Increased elevation of temperature or the occurrence of chills and sweating, being tokens of suppuration, call for prompt resort to the knife. Delay is dangerous, since it renders possible burrowing of the pus. Therefore, in spite of the absence of fluctuation, a free incision in the lumbar region should at once be made down to the perirenal tissue. Then with the finger this should be carefully explored or teased apart until the abscess, which is sometimes deeply seated, is found. The opening made with the finger should be enlarged by inserting a pair of long-bladed hæmostatic forceps and separating the blades. This being done, the abscess-cavity should be washed out and a good-sized drainage-tube inserted. Later, strips of iodoform gauze may be gently pushed into the cavity beside the tube, and the packing gradually lessened and the tube shortened as granulation progresses.

In cases in which the abscess is secondary to disease of the kidney, nephrotomy or nephrectomy may be called for, according to the condition found at the time of operation.

Tumors of the Kidney.

New growths of the kidney, as met with in children, are for the most part, if not entirely, of the malignant class. While it is possible that benign growths may occur, investigation of statistics has failed to find any case which has been the subject of surgical operation. Malignant tumors may involve the kidney either primarily or secondarily, but it is only with the primary tumors that we are here concerned.

Etiology and Pathology.—Some of these growths are congenital. In other cases their origin is attributed either to the irritation of a renal calculus or to injury, such as contusions or falls upon the loin, although it is not very easy to understand how this latter cause can be operative.

Unlike similar formations elsewhere in the body, malignant tumors of the kidney are met with more frequently in the first ten years of life than during the period of life generally recognized as that of malignancy. They may occur at any age in childhood, although the greater number of cases have been observed in children under five. Thus, in 54 cases references to which the writer has obtained, 9 were under one year old, 17 between the ages of one and three, 18 between three and five, 6 between five and eight, and 4 between eight and twelve years of age. As to sex, in 40 cases in which it was stated 22 were females and 18 were males. The tumor is unilateral as a rule. When both organs are the seat of growths, except in cases of congenital myosarcoma, the involvement of one organ is secondary to the disease in the other. Of 30 cases, the right kidney was the seat of the neoplasm in 14, the left in 12, and both were involved in 4.

The great majority of these renal tumors in children are sarcomata. Out of 52 cases, 43 were instances of sarcoma, while 9 were designated as encephaloid carcinoma. The variety of sarcoma most often found is the round-celled, both large and small, the spindle-celled variety being less frequent. These growths, which are first usually encapsuled, but which, owing to their rapid development, soon extend through their capsule, may begin at the hilum and either spread around and envelop the kidney, or they may extend into the kidney, which ultimately becomes stretched out as a thin layer over the tumor. More often they originate in the cortex, being separated from the surrounding renal tissue by a capsule until the latter gives way, when the sarcoma extends throughout the kidney. In addition to the round-celled and spindle-celled, other varieties of sarcoma which have been found are adenomo-sarcoma, in which the sarcomatous tissue and that of the glandular substance of the kidney are combined; myxo-sarcoma, in which the elements of mucous tissue are combined with sarcoma; alveolar sarcoma; and myo-sarcoma and rhabdo-myoma. Tumors of the last-named kind are of congenital origin, and consist of a mixture of striped muscle tissue and sarcoma tissue. They may be either unilateral or bilateral, sometimes reach a very large size, and are rapidly fatal. Owing to special characteristics, certain sarcomata have been described as fibrous and fibro-fatty tumors.

Sarcomata of the kidney grow rapidly and are highly vascular, extravasations often taking place into them. They frequently break down in places and form cysts containing blood and clots.

The variety of carcinoma which has been most frequently met with is the encephaloid, although any of the varieties may be found. Encephaloid cancer of the kidney has sometimes attained immense proportions. The growth may invade the entire kidney, being disseminated throughout it and producing a tumor possessing the general outline of the organ, or it may develop from one part of the organ and have an irregular outline. The origin of the growth is traced to the intertubular connective tissue, its epithelium being derived from proliferation of the normal renal epithelium. Like sarcomata, carcinomata grow rapidly. It is doubtful whether some of the tumors specified in the older classification as encephaloid cancer would not now be placed under the heading of sarcoma.

Lymphadenomata have been occasionally observed in the kidney, but are secondary to disease in the lymphatic system. It is possible that a growth of this kind might be mistaken for a round-celled sarcoma.

Malignant growths of the kidney spread by means of the lymphatics and veins. Carcinomata are particularly apt to involve and extend by the veins. Secondary formations soon take place. The lumbar glands are early infected. The tumor may by pressure cause erosion of the vertebræ, and, opening the spinal canal, involve the meninges, and even the cord itself, by direct extension.

Symptoms.—In addition to tumor, which is the symptom most invariably present, malignant disease of the kidney causes pain, emaciation, cachexia, frequent perhaps involuntary micturition, hæmaturia, and various symptoms resulting from pressure of the growth.

The tumor, if detected early, will be found confined to the loin, where it causes more or less fulness or prominence. In some recorded cases the growth has attained an immense size, occupying the whole abdominal cavity, pressing upward the diaphragm and embarrassing the thoracic organs. Again, in other cases it may be very difficult, if not impossible, to detect a palpable tumor, even though metastasis has taken place. Pain in the lumbar region is an early indication, but while in older children, as in adults, it is an important

sign, it is very doubtful if in very young subjects it could be relied upon, as it is not likely that it would be intelligently located. It is dull in character and usually constant, although occasionally paroxysmal, differing, however, from the pain due to renal calculus in not being either aggravated by motion or relieved by rest. Hæmaturia is not always noted as a symptom. When it does occur it is constant, and although in some cases it may not be alarming, the bleeding may, on the other hand, be very severe. Sometimes clots may obstruct the urethra or may distend the bladder, or, again, may become wedged in the urethra. The hæmorrhage may be due to the calculus from which the tumor may have arisen, or it may result from the neoplasm involving and extending into the pelvis of the kidney and then ulcerating.

The tumor, as it grows, may encroach upon and compress the nerves of the lumbar plexus, giving rise to pain, and even to paralysis in the parts supplied by its branches. From pressure upon the veins within the abdomen œdema of the lower extremities and engorgement of the superficial abdominal veins are produced. Other symptoms due to the pressure of the tumor are constipation, jaundice, anorexia, and vomiting.

The urine will be found normal unless the growth has involved the pelvis of the kidney, when it may contain blood, blood-casts, albumin, epithelium, pus, or portions of the ulcerating tumor. Although convulsions have taken place in a few cases, uræmia rarely, if ever, occurs.

Diagnosis.—The salient symptoms of renal neoplasms are rapidly-increasing tumor and pain. If to these hæmaturia be added, the diagnosis should not be difficult. If the tumor be large, however, there may be some difficulty in deciding whether on the right side it is not a cyst or enlargement of the liver, or on the left whether it is not an enlarged spleen, particularly as renal tumors, as well as those of the liver and spleen, are affected by the movements of respiration. The examination will usually be more satisfactory if the child be under ether or chloroform anæsthesia. The relation of the ascending colon on the right side and the descending colon on the left to these tumors is an important point. Unless the growth be very large or has extended in one particular direction from the kidney, the colon should be found in front of it. In cases where the tumor is very large the bowel may be pushed aside, either inward or downward. Another point of distinction is that renal tumors can usually be traced deeply into the loin. Other affections with which these growths may be confounded are cysts of the ovary, fæcal accumulations, and perityphlitic abscess. Ovarian cysts should have the bowel behind them and not in front, and are generally easily made out by rectal or vaginal examination; and perityphlitic abscess will usually present constitutional symptoms, which, together with the history, will clear up any doubts that may exist.

Prognosis.—Malignant disease of the kidney can of course terminate in only one way. The child may live but a few weeks after the appearance of the growth, or he may live a year perhaps, the average being six or seven months. In children these neoplasms are usually softer, grow faster, and exhibit their malignant nature more speedily than in adults.

Treatment.—The question as to whether operative treatment should be resorted to in malignant renal growths is one that can be answered only after considering the merits of each particular case. Nephrectomy is of course to be thought of only in those cases in which, so far as examination can determine, the disease is in all probability confined to the kidney, under which circumstances there may be some possibility of the removal completely eradicating it, or, if it fails in that, of somewhat prolonging life.

A review of the literature of the subject shows the results of nephrectomy

for renal tumor in children to be not very flattering. The late Prof. S. W. Gross collected 16 operations upon children between sixteen months and seven years of age. Of these, 9 died and 7 recovered from the operation. Of the latter, 5 were known to have died from recurrence of the disease at times varying from five to sixteen months after the operation, while in the remaining 2 the result was not ascertained. Dr. Gross considered nephrectomy to be positively contraindicated in sarcoma in children.

Dr. Marie B. Werner has tabulated 31 operations, including some of those collected by Gross. An additional case is mentioned by Newman in the table in his "*Lectures to Practitioners on the Surgical Diseases of the Kidney.*" Of these 32 cases, 16 survived and 16 perished from the operation. Recurrence is known to have taken place in 8 of the 16 cases which recovered from the operation, the shortest time before death occurred being two months, and the longest eight months. In the other eight cases the ultimate result was not ascertained. One of them died a year and a half after the operation, but the cause of death is not stated.

Butlin, in his work entitled "*The Operative Surgery of Malignant Disease*," says of nephrectomy for sarcoma in children that "not one thoroughly successful case can be claimed, and it is probable that the operation will fall into disrepute."

Judging by the ultimate result in those cases of operation in which it was ascertained, there can be no doubt that the weight of evidence is unfavorable to nephrectomy for malignant disease in children. If there be any hope of success from the operation as a radical measure, it must be when it is performed at a very early period of the disease. Each case, however, must be judged on its own merits. If the operation is to be undertaken, there should be absence of evidence of dissemination of the disease, and the general condition of the child should warrant so severe a procedure. If resorted to, nephrectomy should be performed by the abdominal incision, since the space in the loin in children is insufficient to permit the safe removal of a tumor even if it be of moderate size. The risks of the operation are very considerable, hæmorrhage, shock, collapse, and peritonitis being the imminent dangers encountered. Owing to the high degree of vascularity of these growths the danger of profuse bleeding during their removal, especially if adhesions have to be broken up, is very great.

In cases which do not permit of operation all that can be done is to attempt to afford some palliation for the symptoms to which the tumor gives rise. Pain should be subdued by the administration of opium and the local use of belladonna plaster, or opium, chloral, chloroform, aconite, and belladonna in liniment. Hæmorrhage will call for the employment of hæmostatic remedies, such as gallic acid and ergot. Morris speaks highly of ferric alum for this purpose.

VESICAL CALCULUS.

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Varieties of Calculus found in Children.—The *uric-acid* calculus is by far the most common kind found in children. Statistics by different authors variously place it from two-thirds to five-sixths of all stones. It was first described by Scheele in 1776. It may be composed exclusively of uric acid, or it may be mixed more or less with oxalate of lime and the urates of ammonium and sodium either in its intimate structure or in alternating layers. It is generally oval, rarely very large, and sometimes quite smooth, though more often granular or slightly tuberculated. The color varies from a light fawn—almost white—to a brownish or blackish red. There are two forms—the laminated and the amorphous—although a stone may contain layers of both. The laminated variety, when cut through the centre and polished, resembles an agate; but, besides the concentric curved lines, radiating lines may often be seen extending from the centre to the periphery. This variety is very hard, and when broken splits into angular and often sharp-pointed fragments. The amorphous uric-acid calculus is structureless or sandy on section, and generally of a dirty reddish-yellow color. It is sometimes quite soft and breaks into irregular fragments.

Next in frequency to the uric-acid stone comes the *oxalate-of-lime* or mulberry calculus, first described by Wollaston in 1797. It is generally round, covered with blunt points or spicules, very hard, and varies in color from a dark gray to a brownish black.

Urate of ammonium occasionally occurs as a calculus, but is usually in combination with uric acid. When it does occur it is flattened, oval, smooth, or granular, brittle, and of a clay color.

The *mixed or fusible phosphate*, the *ammoniaco-magnesian phosphate*, *phosphate of calcium*, *carbonate of calcium*, *cystic oxide*, *xanthic oxide*, *fibrinous*, *fatty* (urostealith), and *indigo* calculi are extremely rare, or never occur in children as pure calculi, although some of them may enter into the composition of a stone with uric acid.

Stone in children may be *small* or *large*, from a few grains[1] to an ounce or more; *soft* or *hard*, depending upon its composition and the length of time it has taken to form; *single* or *multiple*; *free* or *attached* to the bladder-walls, either by a band of lymph or by being caught in one of the folds of mucous membrane. It almost always has its origin in the kidney, unless it be formed around some foreign body which has been introduced into the bladder. The

[1] Sir Henry Thompson objects to giving a concretion of less than 20 grains in weight the name of "calculus" or "stone." While there may be some practical advantage in this limitation in the case of adults as regards especially the significance of statistics, there can be none in children.

experiments of Rainey, Ord, Vandyke Carter, and others have shown that "urinary calculus is not an accidental agglomeration of solids, crystalline, and amorphous, in a cement of mucus," but that it is a "massive crystallization of urinary ingredients in a colloid substance," the formation of which occurs in obedience to a fixed law. Although the frequency of the uric-acid calculus is doubtless due to the excess of uric acid in the urine of children and to the presence in the kidneys of infarctions which are almost entirely composed of uric acid, and which Virchow has shown to be very common, almost constant, during infancy, yet it must be remembered that some colloid substance, as mucus, albumin, pus, etc., has to be present or no stone will be formed, and the crystals will pass out with the urine in the well-known cayenne-pepper or brick-dust deposit.

Etiology.—As just stated, the two chief causes of stone are crystals in the urine and the presence of a colloid substance. How far the production of these two causes is influenced by heredity it is very difficult to state.

That stone is occasionally found with exceptional frequency in certain families there can be no doubt, but before its occurrence is assigned to *heredity* it should be remembered that there may be some local cause equally affecting all the members of a family and peculiar to their place of residence, not to their physical condition.

Cadge, some years ago, made the following interesting remarks as to this point: "In five instances I have operated on brothers, and in four other instances I have operated on one brother, and other surgeons on another. Mr. Clubbe of Lowestoft has given us a curious history of a stone-family: Three brothers were cut for stone by Mr. Clubbe; a fourth passed a stone; a fifth child died, aged three months, with every symptom of stone; a female child now has vesical irritation and bloody urine. The father and mother are constantly passing large quantities of lithic acid; the grandfather passed one stone, and the grandmother seven; a great-uncle was cut for stone, and six uncles and four aunts all suffer either with fits of gravel or from lithic deposits; and, to finish, a cousin passes calculi. There is considerable historical testimony in favor of this hypothesis. We know that Montaigne and his father both died of stone in the bladder, and we remember how he moralizes on the incomprehensible wonders of the hereditary transmission of mental and bodily resemblances and infirmities. The celebrated minister Sir Robert Walpole and his brother Horace (who once represented this city in Parliament) were both afflicted with stone; and their mother also had stone."

It is probable that *gout* and *rheumatism* increase any tendency to the formation of stone, as they are usually accompanied by acid urine, with an increase in uric acid and the urates. As gout is hereditary, the tendencies to stone, which it produces, may also be hereditary. But gout, as a rule, is an inheritance of the rich, brought on by generations of over-eating and drinking, and yet it is a remarkable fact that the children of the rich are singularly free from calculus, while the children of the poor make up more than one-half of the cases of stone in the tables of statistics. Deschamps, at the close of the last century, said that during the thirty years in which he treated people afflicted with calculus, he had yet to see the child of a rich man affected with stone. Sir William Fergusson is quoted as saying that he had but once received a fee for operating on a child. Of the 863 cases of stone which Sir Henry Thompson treated in private practice, but 3 were under sixteen years of age, and only 8 from sixteen to twenty-four. In explanation of this Sir Henry Thompson says: "Insufficient food, clothing, and fresh air, the necessary accompaniments of poverty, appear to encourage calculous formations among children, but not

among adults. Habits of self-indulgence, in relation chiefly to diet, and indolence, encourage calculous formation in elderly adult males, but the children of such parents are not so affected. Hard physical labor and a regimen which necessarily contains simple diet, largely cereal, with animal food in small proportion, even although often associated with intemperate habits and with unhealthy dwellings, discourage calculous formations among all classes of the community alike."

It is a well-known fact that stone occurs much more frequently in certain districts than in others, but a satisfactory explanation of this has not been given. It is possible that *climate* may have some slight influence over the production of these affections, as in very changeable regions calculous diseases are more common than in those localities where the temperature is more uniform. This may be due to a lack of proper clothing and insufficient protection of the skin, whereby its functions become disturbed and the kidneys are required to perform an excess of labor. In the United States stone is much more common in Kentucky, Tennessee, Ohio, Virginia, and North Carolina than in any other portions of the country, and yet we have a vast area of territory which is similarly located, geographically, geologically, and climatically, in which stone is rarely if ever encountered. In England calculus is common around Norfolk and Manchester, while in other regions, which are in the same latitude and subject to the same temperature, it is almost unknown. Neither can it be attributed to hard water alone, as Mastin shows that in parts of Kentucky and Tennessee, where the water is soft, calculous diseases are common, and just as frequently met with as in the limestone districts. Again, Mr. Dudgeon of Pekin informs us that at Canton in China stone is frequently met with, while around Pekin it is hardly ever seen; yet the water of Pekin is full of lime, while the Canton water is soft.

It would seem that *race* has some influence over stone formation. The negro in America is said to be remarkably free from calculus, and Rayer says that in Egypt he escapes, while the Arab suffers.

Diet and regimen, at least in the cities, have much more to do with the production of stone than heredity, climate, water, soil, etc.; and I believe that Mr. Cadge has come nearer the cause when he says that the frequency of calculus in children will be found in strict accordance with the difficulty in procuring milk. He adds: "A few years ago, after removing a stone from a child of well-to-do parents, I was remarking to one of my assistants that this was the first instance in my practice, and that I attributed the general absence of stone in such persons to the free use of milk: the mother volunteered the statement that in a large family this was her only child who never could take milk, and who, therefore, never had any."

Sex undoubtedly has an influence upon the frequency of vesical but not of renal calculus. There is no reason why the female is not as liable to the formation of calculous concretions within the kidney as the male; but, the nucleus having once descended to the bladder, the large size and shortness of the urethra, the absence of the prostate, and the comparative freedom from urethral diseases and vesical catarrh are almost sufficient to secure immunity. Giraldès asserts that vesical calculus happens twenty-four times more frequently in boys than in girls, while Neubauer found but 5 girls in 100 cases.

Relative Frequency of Calculus.—Most of the statistics of cases of calculus agree in that children make up one-half or a little more than one-half of the number. In a collection of 1103 cases by Prout, 594 were under fourteen years of age. In Cheselden's series of 213 cases, 115 were under ten and 62 were from ten to twenty years old. Robert Smith's 543 cases from

Leeds and Bristol show 253 to be under sixteen. Sir Henry Thompson's elaborate table of 1827 cases shows that 1001 were under sixteen years of age. In Dolbeau's collection of 5376 cases, 2416 were under the age of puberty. No period of life is exempt from the liability to stone. Langenbeck found a calculus in the bladder of a male fœtus of six months, and Jacobi has reported a case in which the child was only ten days old when symptoms of difficult micturition were noticed, and another case of an infant who passed blood soon after birth, the first urine being voided forty-eight hours later, and a reddish, gritty mass being found in the diapers. He has detected six cases of congenital renal calculi in forty autopsies, and believes that many cases of so-called intestinal colic occurring in children are in truth cases of renal colic. The passage of a calculus is frequently accompanied by hæmorrhage and followed by secondary nephritis.

In Thompson's table the frequency of stone rapidly increases from birth to the fourth and fifth years of life, after which it gradually decreases to the age of puberty. The fallacy of depending upon these figures has, however, been shown by various writers, and Sir Henry Thompson says that after investigating the old statistics of stone and those collected prior to 1850, he found them misleading. He adds: "So far from the stone being more common in children than in adults, according to the universal belief at the period referred to, justified as it was by the records of hospital practice, I was soon in a position to affirm that stone was more common among men of sixty years of age and upward than at any other period of life. For let it be remembered that all existing records of practice, whether found in museums or reported by the operators themselves, from all sources previous to the middle of the present century, showed that half the total number of operations for calculus occurred in childhood and youth. The truth, nevertheless, is that a very large majority of calculous cases was then, as now, to be found in persons above fifty years of age, but the fact was then unknown: the calculi were simply overlooked, not being suspected to exist; and one obvious reason of the oversight is to be found in the fact that the early symptoms in elderly subjects are extremely slight—a rule with only few exceptions—contrasting strongly with the marked and painful symptoms rarely absent in the young."

Agnew, after quoting the figures of Gross, Civiale, and Thompson, showing 62.33 per cent. under twenty years of age, adds: "These estimates, however, are calculated to mislead, from the disparity which must necessarily exist between the different classes of patients when the number of each is contrasted with the entire population living at the same ages. Were the statistics based on this principle, a result the reverse of that exhibited would be shown. In other words, the tendency to calculous disorders would be found to increase with advanced age. The inaccuracy of all statistics with regard to the age of calculous patients will be further shown by the fact that the date has been fixed at the time the patient was operated on, though the disease may have existed several years previously."

Mr. Coulson has made a similar remark, viz. "that an error has crept in from not using the proper precaution to distinguish between absolute and relative numbers. To determine liability the absolute numbers should be corrected by the number of persons living at the several periods of life enumerated. Thus, if all persons under twenty were affected with stone and all over seventy were affected with the like complaint, it is evident that the liability would be the same, though the absolute number of persons attacked would be very different." Mastin says: "To enable us to determine the liability of children of a certain age to stone, we must correct the absolute numbers by the

numbers of persons of all ages living at the several periods of life enumerated. Corrected in this manner statistics would most probably show that young persons are much less liable to calculous affections than is generally believed."

Symptoms.—The symptoms of vesical calculus in children are for the most part the same as in adults, but they present certain peculiarities due to the age of the patient. If the child be not old enough to appreciate when he is sick, and to describe the character and locality of the pain, the surgeon has to rely almost entirely upon objective symptoms for his diagnosis. But if the child be old enough, in many cases, before the development of vesical symptoms, the descent of the nucleus from the kidney will be announced by a group of symptoms known as *nephritic colic.* While feeling perfectly well he is suddenly seized with a violent pain, felt first in the lumbar or hypochondriac region, and rapidly extending down the line of the ureter toward the scrotum and end of the penis. The testicle is drawn upward by spasm of the cremaster muscle. The pain follows the branches of the lumbar plexus into the groin, thigh, and hypogastrium. Vesical irritation and tenesmus are frequent. Faintness, cold sweating, convulsions, and even collapse, may be present. These symptoms may cease as suddenly as they began, but the relief will not be permanent until the stone has passed into the bladder. As long as the stone is in the ureter, the attacks of colic succeed each other at intervals of a few minutes to an hour or more. The urine is high-colored, scanty, and may even be almost suppressed. A history of this kind is an important indication in cases of suspected stone, and should lead the surgeon to make repeated examinations if the following group of symptoms or the majority of them be present:

(1) *Frequent micturition* or *incontinence of urine*, more marked by day than by night; also more marked if the stone has an irregular surface than if it is smooth, and increased by active motion while at play or driving over rough roads. This symptom is more marked and more common in children than in adults.

(2) *Pain.*—The characteristic pain of stone is darting and burning, and is felt during urination, but is most severe at the termination of the act, when the irritated mucous membrane of the empty bladder comes in contact with the calculus. The pain is rarely referred to the bladder, but is felt on the under surface of the penis a short distance behind the external meatus. It is so severe as sometimes in children to cause convulsions, and often continues for a long time or until sufficient urine has collected to remove the walls of the bladder from close contact with the stone. In cases of encysted stone pain may be almost entirely absent. Handling of the penis and traction on the prepuce to relieve the pain gradually stretch the foreskin until it becomes abnormally long, and induce priapism, which, owing to the congestion of the vessels of the prostato-vesical region, often leads in children to the habit of masturbation.

(3) *Sudden Interruption of the Stream during Urination.*—In the early period of the stone, while the calculus is still small and movable, it is often swept into the neck of the bladder and acts as a ball-valve, completely obstructing the vesical orifice of the urethra. The child soon learns the best method of obviating this difficulty, and will assume some peculiar or unusual position which experience has taught him will dislodge the stone and permit the completion of the act.

(4) *Hæmaturia* is rare as a symptom in children. It is due to the wounding of the congested mucous membrane by contact with the calculus, hence it is aggravated by exercise and is most noticeable at the end of urination.

(5) *Evacuation of the bowels during urination*, with prolapse of the rectum, is a frequent symptom when the vesical tenesmus is great on account of the violent straining to void the last few drops of urine.

(6) *The presence of muco-pus in the urine* is a corroborative symptom due to the concomitant cystitis, and is of no special diagnostic value.

(7) *Reflex pains* in different parts of the body are sometimes associated with stone. In many cases the pains will be referred to the rectum or perineum, but sometimes to portions of the body far removed from the seat of the trouble, as in the upper extremities, the back, lungs, stomach, thighs, and feet.

The principal symptoms, then, are frequent desire to urinate, with incontinence or very rarely retention; pain referred to the end of the penis; sudden stoppage of the stream; tenesmus; prolapse of the rectum; and priapism, with occasionally more or less cystitis and hæmaturia.

But the existence of this group of symptoms cannot justify a positive diagnosis of stone unless further it is felt and heard by the surgeon with the aid of the sound. The stone may be in the kidney or under the prepuce. Rectal troubles, prolapse from various irritations, as worms, ulceration, etc., may, by reflex irritation, affect the functions of the bladder apparently as seriously as though it were the principal organ involved. Diseases of the kidneys, phimosis, adherent prepuce, irritating smegma, etc. may also produce analogous symptoms, and, on the other hand, there is no ordinary symptom which may not be absent in a case of stone.

Diagnosis.—The diagnosis of stone is therefore to be made with the sound. Many different forms of vesical sound have been recommended, but the best and simplest has a straight steel shaft with a short curve near the tip and a smooth flattened handle. The tip should be blunt and of slightly larger calibre than the shaft, so that the walls of the urethra may not grasp the shaft so tightly as to interfere with the delicacy of the movements. The curve at the tip should be shorter than in the adult sound, owing to the anatomical difference of the parts in children. Sounding should always be done with the patient under ether unless there is a good reason for not doing so in the special case. The patient should be in a recumbent or semi-recumbent position, the abdominal walls well relaxed by slight elevation of the shoulders, the knees drawn up, and the thighs somewhat separated. During the exploration the bladder should be moderately distended with water. The sound being warm and well oiled, it is held lightly but securely by the handle, and the surgeon should allow it to glide along the upper surface of the urethra, more by its own weight than by using any pushing force. Once in the bladder, the cavity should be explored in a systematic manner. The sound should be partially withdrawn and reinserted in a straight line, the handle being slightly raised and depressed from time to time. The beak of the sound should then be turned toward one side of the bladder, and should be made to traverse the arc of a circle, sweeping transversely through the bladder from above downward. It should then be turned to the opposite side, and the same manœuvre repeated. If the stone is not found in this manner, the searcher should again be introduced to its full length, and the tip turned gently toward the floor of the bladder, and then rotated from side to side, while the instrument is gradually withdrawn until it comes in contact with the vesical neck. If the stone be of moderate size, in nine cases out of ten it is struck and heard at once, and its mobility in the bladder is recognized. So positive are these sensations that the nature of the case is determined even by an inexperienced examiner. A few surgeons consider it sufficient to feel the stone with the tip of the instrument, but the majority prefer to demonstrate its presence by eliciting the characteristic click. The latter is certainly by far the most definite and satisfactory symptom it is possible to obtain, and, although even that does not entirely exclude the possibility of error, it reduces

it to a minimum, especially in children, where tumors with calcareous incrustations are exceedingly rare.

Among the *sources of failure* in the detection of stone are (1), the sound may be pushed through the delicate urethra immediately anterior to its undeveloped prostate, when it would at once enter the ischio-rectal space, where, in the very loose tissues of the child, it may be moved about almost as freely as if it were in the bladder; or (2), without breaking through the urethra, the loosely-attached bladder may be pushed before the sound. This is especially likely to occur in children as compared with adults. (3) A more or less completely encysted condition of the calculus, leaving little or nothing of its surface exposed to immediate touch. This is exceedingly rare in young persons. (4) The presence of a diverticulum containing a stone and communicating with the bladder by a small aperture, the calculus in such a case being practically extra-vesical. This is a condition usually associated with long-continued obstructive disease, and is almost never found in children. (5) The stone may be suspended by a thread of lymph from the summit or the anterior wall of the bladder. (6) The surface of the stone may be covered with a blood-clot or with lymph, so as to prevent the characteristic sound from being elicited.

It is a curious fact in the history of stone in the child, as well as in the adult, that one surgeon may detect the calculus and another of equal experience may miss it.

The examination for stone *in female children* does not differ materially from the same procedure in the male. Owen quotes Holmes's remark: "I hope it may not be impertinent to point out that at very early ages the vagina may be mistaken for the urethra," and adds, "This caution is extremely pertinent: if there be any doubt, a second sound may be deliberately passed into the vagina to prove that the first has entered the bladder; or the finger may be passed into the rectum to show that the vagina is free; or the beak of the sound may be felt for above the pubes."

Preventive Treatment of Stone.—As we have seen, most of the cases in children belong to the ignorant and poorer classes, subjects of improper diet and unfavorable surroundings. If such cases could be treated in the early formative stage, there is no doubt but that much might be done to prevent the formation of stone. In the preventive treatment of calculus the avoidance of catarrhal conditions of the urinary tract is of the greatest importance. The main colloid for acid stone is probably mucus, and a little scratching of the mucous membrane by the points of the crystals or irritation by concentrated urine is sufficient to call out enough mucus to act as a colloid. Our object should then be to make the urine as bland and abundant as possible, and for this purpose there is nothing better than milk and the free use of water as a beverage between meals. The particular kind of water to be used is of minor importance, as the most noted waters in the treatment of stone seem to have purity as their chief recommendation. A proper diet for such a case should be chosen from the following articles: fish, poultry, bread, all cereals, green vegetables, salads, fruits, and eggs. Sugar and the different kinds of fats are harmful, as is an excess of the dark meats. Over-eating is especially and particularly to be avoided. Highly-seasoned articles of food are even more objectionable with children than with adults, as they tend to excess in eating, and in addition often cause acute indigestion or, worse still, a chronic acid dyspepsia.

The *solvent treatment of stone* has but little to recommend it. Brodie tried injections of dilute nitric acid; Roberts has experimented with potassium citrate and acetate; Garrod, with the lithia salts; Vogt, with piperazine;

Beale, with ammonium carbonate, etc. Electrolysis has also been tried even more unsuccessfully.

All these procedures are more objectionable in children than in adults. Vesical injections of all kinds are relatively more irritating on account of the greater delicacy of the mucous membrane. The administration of large doses of alkalies and diuretics by the mouth are almost certain to interfere with digestion, and thus do more harm than good. In the presence of excess of uric acid or urates or oxalates in the shape of crystals, the free use of water, and of small doses of lithia with potassium carbonate, is of great value in prophylaxis; carbonated "lithiated Vichy" water, a commercial product, is often agreeable and useful, but is sometimes disliked by children on account of its effervescence.

Anatomy of the Urinary Organs in Children.—This may be briefly alluded to before describing the operative treatment of stone. In the infant the *bladder* is egg-shaped, having the larger end resting in the pelvis. There is no marked fundus or base to the bladder in the young child, and it is situated mainly in the abdomen. As the pelvic cavity increases in size the bladder gradually descends into it, and the infant about this time assuming the perpendicular attitude, it has been thought that the weight of the urine tends to make the lower part more capacious. Observations upon the dimensions and position of the bladder will naturally vary with the empty or distended state of the organ. Through childhood until toward puberty, when the organs of generation are developed and the neighboring parts assume their normal adult relations, the urinary bladder is always so loosely attached to the pelvic walls that, although it may have settled into the pelvis, it will require very little force to push it upward into the abdomen. This lax condition of the bladder-attachments is of great importance in the consideration of surgical interference in this region. In the young child the anterior wall of the abdomen, from the symphysis pubis almost to the umbilicus, is in close relation to the bladder, and the neck of the bladder and urethral orifice are about on a level with the upper border of the pubic symphysis.

The peritoneum is reflected entirely over the posterior surface of the bladder in the child. The recto-vesical pouch usually embraces the prostatic region very closely, and is liable to injury in children during the operation of lithotomy, causing peritonitis, the most frequent fatal termination in that operation.

The anterior surface of the bladder is always uncovered by the peritoneum in children. The capacity of the bladder in infancy is smaller than in after years, and this may account for the frequency with which young children micturate.

The *prostate gland* is very small in children. According to Sir Henry Thompson, this gland "at the age of seven years weighs only about thirty grains, and between eighteen and twenty years it weighs two hundred and fifty grains, or nearly nine times as much."

The *urethra*, in males, appears to increase slowly in length from birth until puberty is reached. Its canal is more dilatable than was formerly supposed in both adults and children. The meatus is often constricted, so that only a small-sized catheter or sound can be introduced, but if the orifice is incised quite a large instrument will readily pass. The membranous part of the urethra in children is relatively very long, owing to the smallness of the prostate gland at that period of life. In sounding the bladder in a child it should be remembered that the urethra lies close to the rectum, and that its walls are exceedingly thin and delicate.

The degree of curvature of the urethra is greater in the child than in the

adult, but there are variations in this respect naturally following, as do those pertaining to the contiguous parts, upon growth or immature development.

In the *female* the urethra is imbedded in the anterior wall of the vagina, which is sometimes of large size in childhood, and corresponds to the upper part of the prostatic portion of the male passage. It is very distensible.[1]

The Operative Treatment of Stone.—Three methods for removal of stone from the bladder of male children are open to the operator: 1. Suprapubic lithotomy; 2. Perineal lithotomy; 3. Litholapaxy.

The statistics of these operations (see next page) indicate unmistakably the rejection of the first as a routine method in children. It should be reserved for those calculi which are both too large for the perineal operation and too hard for crushing—a very rare combination.

A comparison of the two other methods is, however, of much practical importance at this time, the statistical evidence having only recently justified positive conclusions.[2]

Until comparatively recent times the very low mortality of perineal lithotomy in children in the hands of skilful operators made it seem a work of supererogation to seek for a better method of operation. A safer could scarcely be found. A high rate of mortality after lithotomy was almost always due to deaths among elderly adults. Fergusson and Velpeau, and, later, Freyer, Thompson, and others, objected to the crushing of stone in boys on account of the undeveloped condition of the genito-urinary organs, the smallness of the bladder, the narrowness of the urethra, and the liability to laceration of the vesical and urethral mucous membrane. No instrument had been invented by which litholapaxy could be performed with safety in male children.

Other objections were advanced from time to time, mainly, however, relating to the same anatomical points, and (before the introduction of litholapaxy) to the difficulty of getting rid of the fragments, but the majority of them are now, in the light of the modern improvements in lithotrity, without applicability.

Anæsthesia has made the "extreme sensibility" of the part and the "indocility" of the patients of little moment. Otis has shown that in children, as in adults, the "small diameter of the urethra" may be greatly increased with entire safety. He says that the proportionate relation between the circumference of the urethra and that of the penis, which he has already demonstrated in adults, holds good in children. Thus, with a circumference of penis of one and a half inches, as in a child from two to three years of age, the size of the urethra would not be less than sixteen millimetres in circumference; and this urethral calibre increases or diminishes about two millimetres for every quarter inch added to or subtracted from the penile circumference. It is but fair to mention that Morelli has called attention to a fact upon which some of the success of the Indian surgeons may depend—viz. the very early age at which the children of tropical and Eastern countries reach full sexual development. This may permit the use of larger instruments on an average at a given age than would be possible in Europe or America, and would facilitate and extend the possibilities of litholapaxy.

Antisepsis during and after the operation has minimized the danger of laceration of the mucous membrane; instruments have been made which are at the same time small enough to permit of their introduction into the urethra

[1] For further information I may refer to McClellan's Anatomy, from which the above account has been condensed.

[2] As my opinion, arrived at a few years ago (*Medical News*, May 17, 1890), remains unchanged, and has indeed been strengthened by later experience, I may be excused for summarizing here the views then expressed and making such additions as seem important.

and bladder of young infants, and strong enough to deal with very large and very hard calculi; Bigelow has overcome the difficulty of getting rid of the fragments; and the argument from statistics is at least neutralized by the records of Keegan and Freyer.

Cabot has given the most recent statistics of the three operations, made up from a series of published cases and from others obtained by him. As all the cases were operated upon after 1878, and as they are classified according to age, they are especially valuable for the purpose of this paper. They may be compared as follows for children under fourteen: *Suprapubic lithotomy*, 591 cases; 74 deaths; 12.52 per cent. of mortality. *Perineal lithotomy*, 539 cases; 16 deaths; 2.96 per cent. of mortality. *Litholapaxy*, 241 cases; 4 deaths; 1.66 per cent. of mortality.

Recurrence.—In the face of these figures and of the foregoing facts there is but one argument remaining which, to my mind, has any weight as urged against the operation of litholapaxy in children, and that is the alleged greater probability of recurrence.

As regards the two great classes of operative procedures for the removal of calculus—the cutting and the crushing operations—all forms of lithotomy as compared with all forms of lithotrity and at all ages, there can be little doubt that the statistical evidence in relation to recurrence is at present in favor of lithotomy. But it should not be accepted without reservation. Many of the tables, notably those of Sir Henry Thompson and of Mr. Cadge, are based on an experience extending over many years and antedating the introduction of litholapaxy. Those tables make the proportion of recurrence after lithotrity about 1 in 7 or 1 in 8, and after lithotomy about 1 in 20; but, like so much of the statistical matter which our text-books and journals contain, they are useless or misleading at the present day. The two principal causes which lead to recurrence are—*a*. The failure to remove every portion of stone at the first operation; *b*. The new formation of stone in the kidney and its descent into the bladder. In the tables of Mr. Donald Day, based on the records of the Norwich Hospital, the first class includes two-thirds of all the cases of recurrence. But circumstances have altered. The employment of a large-sized evacuating-tube, the immediate and thorough emptying of the bladder, the minute pulverization usually possible with completely fenestrated lithotrites, the increased knowledge of the great tolerance of the bladder to prolonged manipulations if they are gentle and skilful, have all combined to place the question of recurrence upon a very different level, and to make the collection of a new set of statistics as to recurrence absolutely necessary before venturing to draw any positive conclusions.

But if, for the sake of argument, we investigate existing statistics on this subject, we find that the great majority of cases of relapse or recurrence have taken place in patients past middle life, and especially in very old persons with enlarged prostates and feeble or atonic bladders. It will be recognized at once that these conditions do not prevail in children. The prostate is undeveloped; the bladder is almost an abdominal organ; no pouch exists at the fundus; sacculation is nearly or quite unknown;[1] cystitis is a comparatively manageable complication; the expulsive power is proportionately greater than in the male adult, in whom a "physiological atony" is not at all infrequent. In addition to the reasons above given for not anticipating the formation of new calculi in children around nuclei of vesical origin, it may be reasonably expected that the conditions favoring the development of renal calculi

[1] Fergusson said that even in adults "sacculated stones" were generally met with by young lithotomists.

will be more easily treated and controlled in children than in adults. Certainly among well-to-do people who can carry out a proper system of diet and medication it is fair to suppose that the lithic diathesis, of whatever variety, will be more readily combated in children whose diet and drugs and mode of life can be rigidly administered than in adults with fixed and often very prejudicial habits. Mr. Cadge expressly states that this was true in his own cases, and adds that he has no personal experience of lithotrity in children.

Jacobson at one time asserted that this important matter—the percentage of recurrences after litholapaxy—had been left undealt with by Keegan, then the chief advocate of this operation in male children.

Keegan, in reply, says that in his monograph on the subject (1886) he did not deal with this point, because then he had only had 58 cases in male children and boys. Later (1890), the operation having been on trial for more than seven years, and he having collected 145 cases, 110 of which he had performed himself, he felt competent to consider the question, and said: "As to the outcome of this practice and experience, I have arrived at the conclusion that recurrence of stone does not follow litholapaxy in male children any oftener than it does lateral lithotomy, provided that the former operation be skilfully performed. It will be conceded that recurrence of stone after litholapaxy, when performed on adult and aged male patients, is less than that which in former days followed the now obsolete lithotrity of many sittings. But it must be admitted that recurrence of stone does occasionally follow litholapaxy in old patients. When, however, we come to investigate the causes of this recurrence, we find that the main factors which bring it about in aged patients do not exist in the case of male children and boys." He states that he began in 1881 to use litholapaxy, and that of the 145 cases operated on since but one boy has returned with a second calculus.

Freyer records 3 cases of recurrence in 65 children, the average age of whom was seven and a half years.

For these reasons, while admitting that the question of recurrence is still *sub judice*, I am distinctly of the opinion that there is little probability that there will be enough difference between the proportions of relapses in children after lithotomies and after litholapaxies to justify any decided preference on that ground alone.

The position of litholapaxy in children is moreover strengthened by a review of the history of lithotomy, which, unlike the operation with which we contrast and compare it, has undergone but little change for many years.

The improvements in *suprapubic lithotomy* have, it is true, rendered it applicable to a much wider range of cases, and it is equally true that its most favorable results have been attained in children; but thus far, as we have seen, the statistics of suprapubic lithotomy in children do not compare favorably with those of either litholapaxy or lateral lithotomy. This is probably due to the fact that in a large proportion of cases the operation was selected only after litholapaxy had been attempted and failed, or else was originally chosen on account of the unusual character of the calculus.

It is true that MacCormac has reported 33 cases of suprapubic lithotomy without a death, but they were from scattered sources and did not constitute a consecutive series. There is no means of knowing how many unsuccessful, and therefore unreported, cases occurred during the same period.

It will probably always be employed in preference to lateral or median lithotomy in cases of extremely large or exceptionally hard stones; but when we remember that Freyer has removed by litholapaxy a calculus weighing 808 grains from a boy of nine, and Keegan one of 700 grains (and of uric acid)

from a boy nine and a half, it is evident that neither size nor hardness offers an insuperable bar to the latter operation.

Median lithotomy in children, although advocated by some surgeons, is objectionable on account of the greater danger of wounding the bulb or the rectum, and the difficulties in obtaining space through which to pass the finger into the urethra and the bladder. It is indeed true that the passage of the finger is not absolutely necessary, although it has always been one of the time-honored rules of lithotomy not to withdraw the staff until the finger is in contact with the stone. I have, however, frequently seen Dr. Agnew, when operating on young children, introduce a pair of very small lithotomy forceps along the groove of the staff, separate them, and seize the stone, and then, after the removal of the staff, extract the calculus, the finger never having been in the bladder. I have used the same manœuvre myself with success. I supposed it was original with Dr. Agnew (and believe he was of the same opinion), but I found that Mr. Cadge recommended almost precisely the same method as both safe and efficient, adding, "I dare say it has been adopted by others, but I do not find it alluded to in modern text-books." It must be remembered, however, that its adoption places the surgeon in almost the same situation in regard to the possibility of leaving débris or unnoticed stones in the bladder as he occupies after a litholapaxy. If the stone is soft and breaks down under the forceps, or if there are multiple calculi, he will be dependent on the touch and sound elicited by the vesical explorer, just as after the other operation.

If, then, the introduction of the finger be dispensed with in either median or lateral lithotomy in children, these operations lose one of their alleged advantages—viz. the assurance of the absolute removal of all calculous fragments. If it be insisted upon, it constitutes in a small proportion of cases an unavoidable source of both difficulty and danger. Sir William Fergusson, Keith, Thompson, Cadge, and many others have recorded occasional trouble with this step of the operation. The latter surgeon remarks, apropos of Fergusson's case: "He was a master of the art of operative surgery; if the difficulty occurred to him, we may conclude that it is not unlikely to occur to any of us."

Lateral lithotomy in children, in addition to the special difficulty due to the smallness of the parts, the high position of the bladder above the pelvis, the delicacy and mobility of the deep urethra and the vesical neck, has one possible contra-indication which should not be lost sight of. If the incision be prolonged a little too far backward, the left ejaculatory duct can hardly escape division and subsequent obliteration: and although this may not be a serious accident in cases in which the integrity of the opposite half of the genitals, the testicle, duct, etc., is unimpaired, yet it leaves the patient entirely dependent on that one side for fertility if not for potency. Mr. Teevan has reported four cases of sterile husbands among lithotomized patients. Langenbeck and Sir William MacCormac have called attention to the same danger, and Keegan believes the lateral operation to be frequently followed by emasculation. Dennis quotes Dr. Charles Leale in relation to several cases coming under his own observation, in which such patients grew up with shrill voices, atrophied testicles, absence of hair upon the face, etc.; in fact, with all the characteristics of eunuchs. The evidence as to this point is as yet fragmentary and inconclusive, but is of sufficient importance to deserve careful consideration, although Ehrmann characterizes the fear of sterility as a "bugbear."

The objections to perineal lithotomy in children are, however, at least as weighty as any that have been urged against litholapaxy.

The ease and satisfaction to both patient and surgeon with which the latter

operation may be performed I can best illustrate by a brief abstract of one of the earliest of my own cases:

C. W——, a small boy, aged five and a half, was brought to me by his father in October, 1889, on account of nocturnal incontinence of urine. He had a long, tightly-adherent prepuce with pin-point aperture. It "ballooned" at each act of urination. I circumcised him, gave small doses of belladonna and bromide of sodium, and dismissed him, apparently cured, in November.

In January he was brought to me again by his nurse, who told me that his symptoms had returned. I then sounded him for stone, but failed to find it. Insisting (according to my invariable rule in such cases) upon a second examination before giving a positive opinion, I easily found a calculus. I recommended crushing, and after a little delay the parents consented. On February 20th, the child being etherized, I drew off the urine and injected three ounces of warm boric-acid solution (fifteen grains to the ounce) into the bladder. I then enlarged the meatus[1] and introduced a Weiss fenestrated lithotrite, No. 16 French. This went in with ease. The stone was readily seized and broken. I spent twenty-five minutes in pulverizing it, paying especial attention to gentleness of movement and to the avoidance of rude or unnecessarily wide separation of the jaws of the instrument. A No. 16 tube was then introduced and a Bigelow evacuator employed. In about eighteen minutes,[2] as no more fragments or dust could be perceived, the tube was withdrawn and the bladder carefully explored with a vesical sound. Nothing was discoverable.

The time of operation was forty-three minutes; weight of dried calculus, 170 grains. The child was sitting up in bed on February 22d, and was out of bed, playing about the room, on February 25th. The nocturnal incontinence persisted for a week or ten days, and then disappeared entirely. There was no fever, bleeding, chill, or other alarming symptoms.

The parents were nervous, consented reluctantly to this operation, and would certainly have postponed a lithotomy for a long time, much to the child's detriment.

This is a typical case of litholapaxy in a young boy. I have now had many such cases, and have never had a moment's anxiety about the little patients. It can scarcely be wondered at that after his experience Keegan writes that he would as soon think of cutting an old man for the removal of a small stone as of performing lateral lithotomy on a boy whose urethra would readily admit the passage of a No. 8 (No. 15 French) lithotrite, and whose stone was neither abnormally large nor hard. Nor is it surprising that Freyer says that, lithotomy in the adult having been practically blotted out of his practice, he looks forward confidently to lithotomy in children meeting with a similar fate. Freyer says: "When, in 1885, Keegan first showed that Bigelow's operation was capable of successful extension to the case of male children, I lost no time in procuring the necessary instruments and applying the operation to such cases. In two papers I placed before the profession full details of

[1] Otis recommends performing the meatotomy long enough before the litholapaxy to allow the parts to heal. This is certainly desirable for some reasons, but in nervous children its advantages are counterbalanced by the need for two fixed appointments, two operations, etc. I have never found any harm resulting from the plan I here followed.

[2] The pressure on the rubber bulb during the process of evacuation should be slight and frequent rather than slow and vigorous. Prof. Bigelow himself called my attention to the much greater value of the former method, and I have repeatedly verified the correctness of the statement. Not only is the danger of driving back into the bladder sharp fragments of stone materially lessened, but the swiftness and effectiveness of the outward current are much increased. I so often see an entirely unnecessary degree of force expended in the working of the bulb during this stage of a litholapaxy, even by expert operators, that it seems worth while to make this note.

49 cases of litholapaxy undertaken by me in male children or boys below the age of puberty. Since then 67 males of fifteen years and under, suffering from stone, have come under treatment, and in 66 of these I have performed litholapaxy—in all with complete success. In only one instance was it necessary to have recourse to lithotomy (suprapubic). The greater my experience of litholapaxy amongst male children becomes, the more I am fascinated by this operation. Though the average number of days such cases were kept in hospital was five and a half as a rule, these little patients may be seen playing about the day after the operation, perfectly happy and untroubled by urinary symptoms of any kind."

Cadge, MacCormac, Jacobson, Kingston, Keyes, Hunt—indeed, most recent writers—press the conviction, though in less sweeping terms, that the field of litholapaxy in children is likely to be considerably enlarged in the near future.

I have once, in a patient of Dr. E. L. Duer's, been compelled to abandon the operation on account of the impossibility of inserting the evacuator, although a lithotrite of equal calibre had gone in easily. Walsham and Marshall have called attention to the necessity of having a number of sizes of lithotrites and evacuating tubes, as they had both found great difficulty toward the end of the operation in children in introducing an instrument which had passed easily at its commencement. This is the only experience of the sort I have had in a child. The patient, aet. ten years, passed 40 grains of detritus, and a few weeks later I removed a calculus weighing 240 grains by the lateral operation. Convalescence was then uninterrupted.

Basing my opinion on the facts mentioned in this paper and on my personal experience, I believe the following conclusions to be justifiable:

1. In every case of calculus in male children[1] litholapaxy, on account of ease of performance, low mortality, speedy recovery, and absence of danger of emasculation, should be the operation of predilection, division of the meatus being freely resorted to if that portion of the urethra offers an obstacle to the introduction of instruments.

2. The lithotrite and evacuating-tube should be of a size which can be inserted into the bladder without much effort or over-distention, and great gentleness should be observed in passing these instruments. Keegan says: "When I advocate litholapaxy as being the best operation, in my opinion, for the great majority of stones occurring in male children and boys, I do so with a very important reservation—viz. that no one should attempt to perform it in boys until he has first gained some practical experience of it in adult males. The surgeon who meets with cases of stone only at rare intervals during his career will be acting more wisely if he adheres to lateral lithotomy or suprapubic cystotomy. It is his misfortune, and not his fault, that he has not been afforded many opportunities of gaining a practical familiarity with the use of the lithotrite."

3. The instruments should be withdrawn and reintroduced as seldom as possible, the stone being finely pulverized before the lithotrite is taken out at all. In seeking for or attempting to seize the stone care should be taken to avoid such wide separation of the blades as will bring the male blade in frequent contact with the vesical neck. The crushing should invariably be done only after rotating the blades into the centre of the bladder. Every particle of the calculous dust should be evacuated.

4. Rest in bed, milk diet, and sterilization of the urine by boric acid or

[1] These remarks apply almost as well to adults.

salol given internally, both before and after the operation, are valuable adjuvants. During the operation every antiseptic precaution should be observed.

Southam very properly emphasizes the importance—*a*, of this preliminary sterilization of the urine by the administration of salol and boric acid, and if need be by irrigation of the bladder; and *b*, the avoidance of shock by thorough protection of the patient against surface chilling.

5. The exceptional cases of calculi which are both large and hard may be best treated by suprapubic lithotomy, but neither unusual size nor a moderate degree of density should of itself alone be thought positively to contraindicate litholapaxy.

6. Perineal lithotomy has now a very limited field, and should be employed chiefly in those cases of stone thought to be of small or medium size, in which no lithotrite, however small, can be introduced with safety.[1]

Operative Treatment for Stone in Female Children.—Surgical opinion in regard to the choice of operation in female children has not as yet become so definitely established. The possible methods are—

a. Vaginal Lithotomy, which is attended with much disturbance of the parts, requires over-stretching of the vagina, section of the fourchette, destruction of the hymen, etc., and which, even in good hands, has not infrequently been followed by a permanent vesico-vaginal fistula.

b. Dilatation of the Urethra.—This is easy and safe in the case of small stones, but in larger ones, and especially if incision of the urethra is required, is extremely liable to be followed by incontinence.

c. Suprapubic Lithotomy.—This is at present the operation of choice with many surgeons. Jacobson thinks it would be wiser to make use of it in all but the very smallest stones. He adds: "I would refer my readers to a case of suprapubic operation by Mr. Barwell in a child aged nine, from whom a stone weighing two and a half ounces was successfully removed. It is interesting to note that Mr. Barwell was led to adopt the suprapubic operation from his having had within seven months no less than three cases of vesico-vaginal fistulæ originating in the extraction of calculi during infancy and youth by different surgeons."

d. Litholapaxy.—The statistics which are slowly accumulating (chiefly from Indian sources) tend to show that this will be the operation of the future, but cases of stone in female children are so rare comparatively that the figures thus far available cannot be regarded as conclusive. The difficulty of crushing in such small bladders has been alluded to, but it is usually not greater than in the case of males. If a lithotrite and a fair-size evacuating-tube can be inserted without over-distention of the urethra, there would seem to be no *a-priori* reason why the operation should not be as successful in females as in males.

The details of the performance of the various operations in both male and female children belong to the systematic works on general and operative surgery, and need not here be considered.

It may be remarked, finally, however, that an improvement in results scarcely less than that found in other branches of surgery has followed the introduction of antisepsis into genito-urinary work, and that, whichever operation is selected in a given case of vesical calculus in a child, the little patient is on the average safer to-day than he was in the hands of even the most skilful operator twenty-five years ago.[2]

[1] *An American Text-Book of Surgery*, 1892.

[2] I desire to acknowledge my obligation to Dr. Robert G. Le Conte for the collection of much statistical matter upon which some of the above statements are based and for further aid in the preparation of this article.

GONORRHŒA AND VULVO-VAGINITIS.

By J. WILLIAM WHITE, M. D.,

Philadelphia.

I. Gonorrhœa in Male Children.

In male children specific urethritis does not differ materially in its course, symptoms, and complications from the same disease in the adult. The cause is often some sexual relation established between the child and an adult female for purposes of sexual gratification of the latter, even though the boy may be so young that intromission is impossible. In other cases mediate contagion has occurred by means of dirty clothing, towels, or cloths used by older persons of the same household, etc. In others, chiefly in boys near the age of puberty, the disease is acquired in the customary manner—*i. e.* during actual or attempted intercourse.

Symptoms.—The usual symptoms, purulent discharge, ardor urinæ, chordee, frequent urination, etc., are present. Of the complications, phimosis and balano-posthitis are more common than in the adult, owing to the relatively excessive length of the prepuce and to the delicate character of the mucous membrane lining it and covering the glans. Cystitis is not uncommon; epididymitis is more so. Prostatitis, as might be expected, is almost unknown, or at least cannot be differentiated from vesical inflammation. The intensity of the urethritis and the severity of the symptoms are both rather greater than in the average case in the adult, and the accompanying constitutional disturbance is much more marked.

Diagnosis.—As such cases are not infrequently the basis of legal proceedings, the physician should be especially guarded in pronouncing upon the character of the disease in any given instance. While specific urethritis can usually be traced to one or the other of the causes above named, there are many cases of simple urethritis which are clinically indistinguishable, and the non-specific nature of which can only be recognized by the absence of a history of infection on the one hand, and by the existence of a sufficient traumatism, such as the passage of instruments, the ejection of a calculus, etc., on the other. I have seen severe urethral inflammation follow retention and decomposition of smegma beneath a long, tight prepuce, the orifice of which was so small that "ballooning" occurred with each act of urination. In such cases a small quantity of urine is always retained beneath the foreskin, and cleanliness is impossible. In comparison, however, with the number of cases in which this condition exists in children the frequency of occurrence of urethritis as a result is extremely small, and caution should be observed in attributing a particular urethritis to this cause.

While bacteriological investigation will throw much light upon the etiology of a case of this kind, our information is not yet definite enough to enable us to predicate absolutely upon the presence of the gonococcus the specific char-

acter of the inflammation. It renders it highly probable that the disease is the result of infection, direct or indirect, from another person having the same disease, but it is not yet safe to say more than that. Competent observers, such as Bumm, assert that in the normal urethra a diplococcus is found having all the peculiarities of the gonococcus. If this be true, even if it occurs with great rarity, it is apparent that it destroys the diagnostic value of the gonococcus in medico-legal cases. A knowledge of its presence is, however, of use clinically, as indicating an inflammation of more severe type than the simple urethritis in which the infection has been exclusively with staphylococci or streptococci.

Treatment.—The child should be kept in bed. If there is marked phimosis, the prepuce should be slit up the dorsum, or, if the œdema and inflammatory exudate are not too extensive, a formal circumcision should be performed. The organ should be wrapped in cloths wet with lead-water and laudanum, and the constitutional disturbance controlled by mild laxatives, small doses of aconite, and full doses of potassium bromide. An excellent formula is the following, the doses of which are proper for a child five years of age:

℞. Potassii bromidi . . . . . ʒj.
Acid. borici . . . . . gr. xlviij.
Tinct. aconiti . . . . . ♏iij.
Tinct. belladonnæ . . . . . ♏xij.
Spts. ætheris nitrosi . . . . . fʒiij.
Mist. potassii citrat. . . . . q. s. ad fʒvj.—M.
Sig. Dessertspoonful in water every two hours.

The diet should consist almost exclusively of milk.

When the inflammatory symptoms have subsided the use of injections may be begun. They should be from one-half to two-thirds of the strength required for the adult, and the excellent rule applicable to the latter should not be deviated from—viz. to avoid the production of pain by the free dilution of the injection to any necessary extent.

It is often well to begin with a lead-and-laudanum injection, substituting the extract of opium for the tincture:

℞. Ext. opii aq. . . . . gr. vj.
Liq. plumbi subacetat. dil. . . . . fʒvj.—M.
Sig. Use locally.

Later, an antiseptic and astringent injection like the following may be employed with advantage:

℞. Hydrarg. chlorid. corros. . . . . gr. $\frac{1}{30}$.
Acid. boric. . . . . ʒj.
Zinci sulpho-carbolat. . . . . gr. xij.
Liq. hydrogen peroxid. . . . . fʒss.
Aquæ rosæ . . . . . fʒvss.—M.
Sig. Use locally.

These injections should be given by a nurse immediately after the child has urinated. From half a drachm to a drachm is a sufficient quantity to throw in at one time.

During the subsiding stage the internal administration of salol will be of use, and if an irregular febrile movement persists, as is sometimes the case, full doses of quinine night and morning will be of great value.

II. Vulvo-vaginitis.

The vulvo-vaginitis of children may be—*a*, Catarrhal or irritative; *b*, Gonorrhœal.

a. The catarrhal form is caused by any simple irritant, the commonest causes being the prolonged contact of the parts with filthy diapers, the retention of urinous and sometimes of fæcal matter between the labia, all forms of dirt, seat-worms, etc. It may be excited by any traumatism or by an attempt at rape. It is an almost pure vulvitis, the vagina being but slightly involved and the urethra very rarely.

It is characterized by the ordinary symptoms of inflammation, heat, swelling, redness, pain or itching, and sometimes by extensive excoriation or actual ulceration.

b. The gonorrhœal form is much more severe. There is free purulent discharge, much swelling of the external genitalia, intense hyperæmia of the mucous surfaces, which bleed readily when touched, ardor urinæ, pelvic and abdominal pain, and often some endometritis, with tenderness and swelling of the uterus.

The constitutional symptoms are quite marked. The fever often has a high range and is very persistent. The local conditions are apt to be rebellious to treatment.

Diagnosis.—The diagnosis between these two conditions is often a matter of the gravest importance, not so much perhaps to the little patient as to others who may be suspected of being the source of infection.

The clinical diagnosis will be based upon the presence or absence of the causes of catarrhal vulvitis enumerated above, and upon the extent and character of the symptoms. The catarrhal variety is not markedly contagious, does not give rise to purulent ophthalmia, and yields readily to treatment. The reverse is true of the gonorrhœal variety. The former occurs most frequently during the first two years of life; the latter, from the third to the seventh year.

The bacteriological diagnosis is open to the same uncertainties as have been mentioned in relation to urethritis in male children.

One of the most carefully observed cases which has been recorded is reported by Dr. Edward Martin,[1] and appears to show that the discharge from a case of vulvo-vaginitis acquired in an entirely non-venereal manner, apparently originating *de novo*, is capable of exciting a severe attack of typical gonorrhœa when inoculated in a healthy urethra. In 5 of 9 cases he made careful microscopic examinations, and found gonococci present in all. In all but one the possibility of contagion was positively denied.

The general evidence shows a remarkable difference between the histories of some of the cases and their bacteriology, as in the above instances, and also between the results arrived at by different observers. Vibert and Bordas in six cases of purely *traumatic* vulvo-vaginitis found diplococci absolutely identical with the gonococci. On the other hand, Martin failed to find gonococci in a single case of irritative vulvo-vaginitis, although he examined a considerable number. It is apparent, therefore, that the mere presence of the

[1] *Jour. of Cut. and Gen. Urin. Dis.*, November, 1892. Dr. Martin's excellent article contains a résumé of the latest observations on this subject, and may be referred to with advantage. I have used it in the preparation of this paper.

gonococcus does not justify the unreserved diagnosis of specific infection, although it may be said strongly to favor that view and practically to establish it when the clinical symptoms coincide.

When the disease appears at a very early age, it is almost always the result of infection from a gonorrhœal inflammation of some portion of the generative tract of the mother. Later, especially if there is an accusation of rape directed against any one, it is well to remember that the same liability exists, and that the disease may have been carried by the fingers or garments of the mother.

Treatment.—In the catarrhal variety absolute cleanliness, obtained by frequent bathing in warm water and soap and favored by first pouring carbolized oil (1 : 60) over the region, dryness of the parts produced by the gentle use of absorbent cotton, separation of the labia by portions of cotton or gauze, and the use of some dusting powder, such as that given below, are the essentials of treatment:

℞. Pulv. zinci oxidi, ...
Pulv. acid. boric. . . . . *āā.* ℥ss.
Pulv. amyli . . . . . ℥j.

In the gonorrhœal form a little more active treatment is required. Vaginal douches of hot soda solution or of soapsuds, followed by antiseptic irrigation, are to be employed two or three times daily; the soda may be of the strength of 1 per cent; the antiseptic solution should contain bichloride of mercury (1 : 4000), or carbolic acid (1 : 100), or boric and salicylic acids (10 gr. of the former and 5 gr. of the latter to f℥j), or silver nitrate (1 : 5000). It is important after each irrigation to dry the parts carefully but gently, and then to use a dusting powder, keeping the labia separated.

If the urethra is involved, and especially if there are evidences of cystitis, the internal administration of boric acid and salol, or of some such mixture as that previously given for the same disease in boys, will be found useful.

In all varieties of this disease the general health of the little patient should be scrupulously looked after, as struma, anæmia, and digestive derangements are frequently found associated with local causes in producing the symptoms or favoring their continuance.

PHIMOSIS, ADHERENT PREPUCE, PARA-PHIMOSIS.

By HENRY R. WHARTON, M. D.,

Philadelphia.

I. Phimosis and Adherent Prepuce.

Phimosis consists in a contraction of the orifice of the prepuce, which is frequently associated with elongation of the prepuce, preventing the exposure of the glans penis. The condition may be either congenital or acquired. In congenital cases the contraction is much more marked in the inner or mucous layer of the prepuce, which adheres closely to the glans penis. Acquired phimosis is usually seen in children who have suffered from balanitis, and is not common in very young children. Adherent prepuce is a very common condition during early infancy, and is often associated with phimosis: this adhesion by pressure tends to dwarf the growth of the glans penis, and causes accumulation of smegma, which may harden and act as a foreign body. I have frequently seen in cases of adherent prepuce a complete cast of hardened smegma filling up the groove behind the corona.

Phimosis with adherent prepuce, as has been stated before, is almost always present in male infants at birth, but as the child develops the condition usually disappears, and in many cases no symptoms are developed referable to it; on the other hand, there are often mechanical irritations and reflex nervous disturbances which can be traced to the presence of phimosis, such as malnutrition, choreic movements, paralysis, convulsions, nocturnal incontinence of urine, dysuria, prolapsus of the rectum, and hernia, the latter conditions being most frequently seen where there is marked contraction of the preputial orifice and severe straining efforts are made during micturition. Adherent prepuce with retained smegma in young infants frequently produces priapism, vesical irritation, defective nutrition, and restlessness at night, which conditions are usually relieved by exposure of the glans. In older children the condition of phimosis with adhesions is apt to give rise to priapism, and is unquestionably the cause of the habit of masturbation in young boys. Bearing in mind these facts, it seems the part of wisdom for the physician to investigate the condition of the genital organs in all male infants, to ascertain the fact that the prepuce and the glans are separable; and it is especially important in any obscure diseases developing in infancy and childhood that this examination should not be neglected.

In cases where the preputial orifice is very small, as in Fig. 2 (Plate XXII.), the adhesion of the mucous layer of the prepuce to the glans penis is usually very firm, and as the glans cannot be exposed, the adhesion becomes firmer as the patient increases in age, so that to expose the glans it is often necessary to dissect the mucous layer of the prepuce from the glans.

It is an unquestionable fact that preputial adhesions are separated spon-

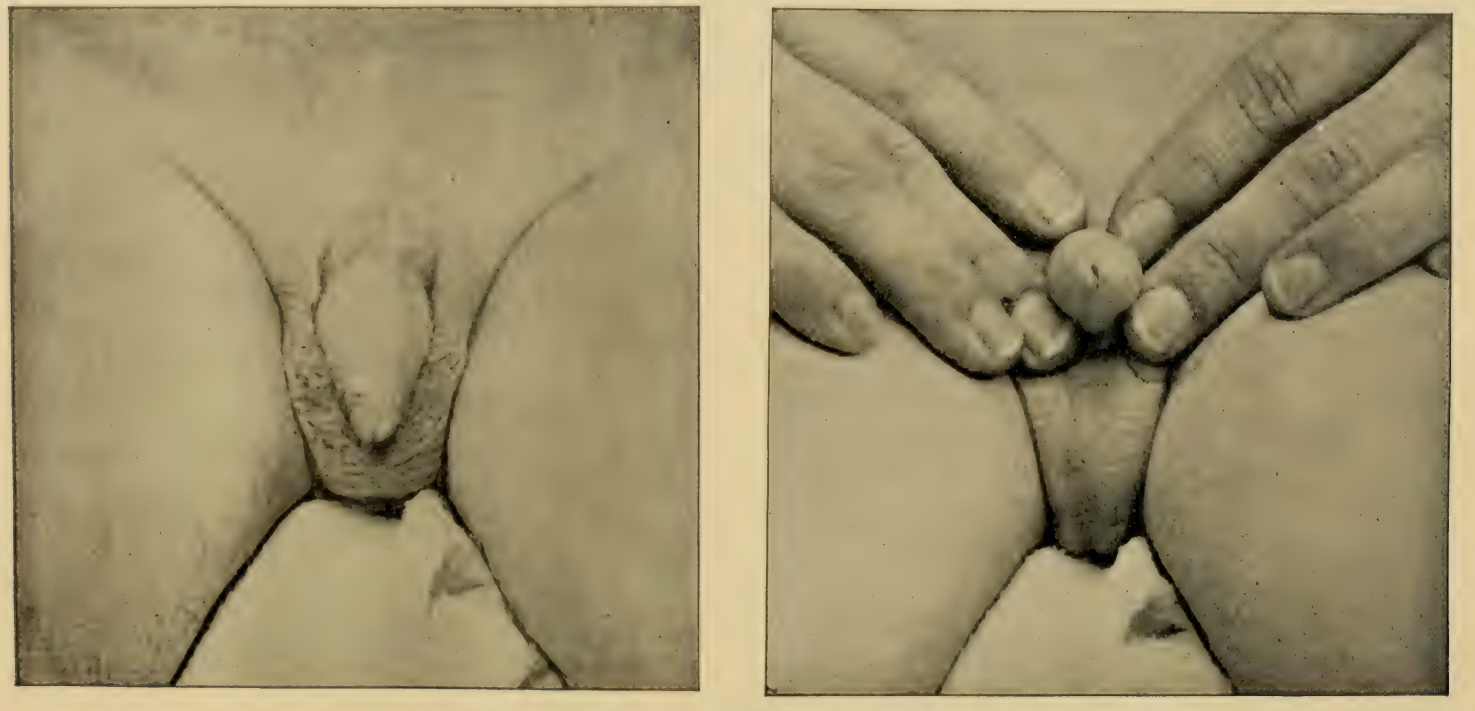
taneously, and that the condition of phimosis is outgrown, and that many cases reach adult life without presenting any symptoms due to the condition described. But when we consider that a very trivial operation in infancy will relieve the condition which may later gives rise to serious symptoms, it seems to me to be wise to stretch the prepuce and separate the adhesions in all cases. If phimosis still exists and symptoms are present, it can be relieved later by operative interference.

Treatment of Adherent Prepuce.—This condition is best relieved by stripping the glans, which is accomplished as follows: The foreskin should be drawn slowly backward until the point of adhesion is reached, by grasping the penis between the finger and thumb and making traction upon the margin of the ring in this way: by passing the end of a silver probe around the adhesions between the mucous membrane and the glans, they can usually be separated without difficulty. When all adhesions have been separated and any collections of smegma about the corona have been removed, which is best accomplished with the end of a probe, the foreskin should be movable upon the glans. The exposed surface of the glans should then be anointed with carbolized oil or boracic-acid ointment, and the prepuce again brought forward, care being taken not to keep the foreskin back for any considerable time, as the condition of paraphimosis soon develops, and much difficulty may be experienced in its reduction. This manipulation should be repeated at intervals of a few days, and in ten days or two weeks it will be found that no tendency to readhesion exists. When there is very marked contraction of the preputial orifice, so that the glans cannot be exposed, it is necessary to resort to dilatation or stretching, excision, or circumcision of the prepuce.

Dilatation.—This method of relieving phimosis is accomplished by introducing into the preputial orifice the blades of a pair of dressing or dissecting forceps, or forceps specially devised for the purpose, and separating the blades, thus stretching or rupturing the mucous membrane until the glans can be freely exposed; when this is accomplished, it should be covered with carbolized oil or boracic-acid ointment, and the foreskin should again be brought forward. The manipulation should be repeated at intervals of two or three days for several weeks, until the glans can be exposed without difficulty. The disadvantage of forcible dilatation of the prepuce lies in the fact that there is often a considerable amount of inflammatory induration of the mucous membrane following the procedure, and forcible dilatation has been followed by gangrene of the prepuce. I have knowledge of one case in which this unfortunate complication resulted. Therefore, the procedure is, I think, not to be generally recommended, but, judiciously employed in connection with stripping of the glans, it is often of advantage; but in severe cases it is better to resort to excision or circumcision.

Excision.—This procedure for the relief of phimosis consists in first incising the foreskin on the dorsum of the glans from the preputial opening to the corona glandis; the flaps thus made, consisting of skin and mucous membrane, are seized with forceps and trimmed off with scissors, so as to make an oval wound. In performing this operation it is well to introduce the end of a grooved director into the preputial orifice and pass it backward over the dorsum of the glans penis to the corona glandis; the tissues upon the director are next divided with a bistoury or scissors to the corona glandis; the flaps resulting are seized with forceps and trimmed off with a scalpel or scissors, so as to make an oval wound, the frænum being left intact; a few stitches of catgut or fine silk are next introduced to hold the skin and mucous membrane together, and the wound is dressed with boracic-acid ointment spread on lint. The result

PLATE XXII.



PHIMOSIS, SHOWING PIN-POINT ORIFICE.

following this operation is usually very satisfactory, and it will be found most serviceable in cases where the prepuce is indurated or œdematous as a result of balanitis.

Circumcision.—This operation in most cases of phimosis, and particularly in congenital cases, is the one which is to be selected as securing the most satisfactory removal of the redundant prepuce and the freest exposure of the glans penis. In performing the operation of circumcision the foreskin should be drawn slightly forward and the blades of a pair of forceps, preferably Ricord's fenestrated forceps, or a modification of this instrument, fenestrated spring forceps (Fig. 1), should be placed obliquely upon the foreskin, so that more

Fig. 1.



Fenestrated Spring Forceps.

tissue is included in the region of the corona glandis than in the region of the frænum, care being taken to see that a sufficient quantity of skin is removed, and that no portion of the glans is included in the grasp of the forceps. Neglect of the former precaution often leads to the production of a secondary phimosis after healing has taken place, and a subsequent operation is required to expose the glans. I have been called upon to do a number of secondary circumcisions which were necessitated by the operators having failed to remove a sufficient quantity of the foreskin to expose the glans completely; it is an error which inexperienced operators are apt to commit. The forceps being placed as above described, a narrow bistoury is passed into the fenestra, and the tissues between the blades are divided; or the same purpose may be attained by cutting with scissors close to the forceps. The forceps are then removed and the skin retracts. It will often be found that the mucous membrane has not been divided or has only been slightly removed. If this be the case, it should be divided upon the dorsal surface of the glans and corona by introducing a director and dividing the mucous membrane with bistoury or scissors; any adhesions to the glans should be separated with the end of the director. The triangular flaps of mucous membrane thus resulting should next be seized with forceps, and trimmed off with scissors to correspond to the line of the skin incision. There is usually little hæmorrhage, but occasionally the arteries of the frænum or a dorsal artery or vein bleed freely, in which case they should be secured by means of fine catgut ligatures. To secure prompt healing of the wound the hæmorrhage should be perfectly controlled before the skin and mucous membrane are sutured together. I have seen neglect to control the bleeding at the time of operation give rise to troublesome consecutive hæmorrhage, resulting in great swelling of the penis as the blood escaped into the loose cellular tissue; and I have also seen a child almost exsanguinated by slow consecutive hæmorrhage from the artery of the frænum which had gone on for hours after circumcision. To avoid this complication, I think it is a matter of the first importance to check all bleeding, even if insignificant, at the time of operation, and not to depend upon controlling a hæmorrhage by the final suturing of the wound, as is often recommended. After the mucous membrane has been trimmed, the edges of skin and mucous membrane should next be brought in apposition by introducing fine silk or catgut sutures. I usually employ a fine chromicized catgut suture, as it does not require subsequent removal. The first two sutures are introduced, one at the frænum and the other at the middle line of the dorsum; two more sutures on

each side are usually sufficient. The appearance of the parts immediately after circumcision in the case already depicted, in which there were firm adhesions between the mucous membrane and glans, is seen in the accompanying plate. (Plate XXIII.)

The surface of the glans and the sulcus behind the corona should be dressed with boracic-acid ointment or carbolized zinc ointment, and a dry dressing of sterilized or carbolized gauze may be wrapped around the penis to cover the wound, or a wet dressing, consisting of boracic acid, glycerin, and water, may be employed in the same manner. The dressing may be held in place by the turns of a narrow roller bandage or by the T bandage or by the child's napkin. Subsequent dressings are made daily, and at the end of a week the union is generally complete in the line of incision. Some œdema of the mucous membrane may persist for weeks, but it usually disappears in a short time.

II. Paraphimosis.

This name is given to the condition in which an abnormally narrow prepuce has been drawn up above the corona glandis and remains irreducible. When this accident happens the glans soon becomes swollen and œdematous from the constriction exercised by the edges of the preputial orifice, and, if the condition is not promptly relieved, ulceration or gangrene may occur. Paraphimosis is usually met with in boys who retract the prepuce and fail to replace it promptly, or may result from the trick of tying strings or bands around the root of the penis. One of the most aggravating cases I have ever seen was caused by an ignorant nurse tying a string around a boy's penis to control nocturnal enuresis. I have also seen the condition resulting in young children from the bites of insects. When paraphimosis has existed for some time, the swelling and œdema of the glans and mucous membrane become so marked that the greatest distortion of the organ occurs; the appearance is well presented in Fig. 2.

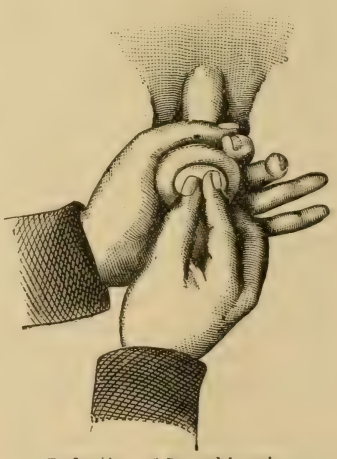
Fig. 2.



Paraphimosis.

Treatment.—When seen early these cases can be quickly relieved by grasping the lateral folds of skin between the thumb and finger of the left hand, and drawing the foreskin forward at the same time as the thumb and forefinger of the right hand compress the glans and push it backward within the advancing ring (Fig. 3). In cases where this manipulation does not succeed minute punctures of the œdematous mucous membrane with a sharp-pointed bistoury will often cause a decided diminution in its bulk by the escaped serum, so that the above manipulation will then often be followed by success. Should this procedure fail, it is better to anæsthetize the patient and resort to operative measures. The operative treatment to effect the reduction of the paraphimosis consists in introducing the end of a blunt-pointed bistoury under the edge of the prepuce and dividing it freely

Fig. 3.



Reduction of Paraphimosis.

PLATE XXIII.



PHIMOSIS, SHOWING APPEARANCE AFTER CIRCUMCISION.

on the dorsum of the glans, or the constricting tissue may be divided at two or three points. After this has been done the glans can usually be reduced without trouble. The after-treatment consists in the application for a few days of a lotion of carbolic acid, chloride of ammonium, glycerin, and water until all swelling has disappeared. When paraphimosis has once occurred, it is better, after the parts have resumed their normal condition, to circumcise the patient and prevent the possibility of a repetition of the accident.

PART XI.

DISEASES OF THE SKIN.

By W. A. HARDAWAY, A. M., M. D.,

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In a general way it may be said that the child and the adult are subject to very nearly the same diseases of the skin; nevertheless, a close scrutiny will show that certain differences exist, both of kind and degree, that are worth attentive consideration.[1]

In the first place, owing to the greater vulnerability of the skin in children, inflammatory disorders of all sorts take on a more acute aspect than with the grown person, and, for the same reason, mechanical irritants are more apt to be productive of mischief. Then, again, the frequent gastro-intestinal disorders of infancy increase, in an indirect way, the tendency to inflammatory and erythematous cutaneous processes. Although the influence of dentition is much overrated as an etiological factor, it remains true that the nervous erethism set up by the eruption of teeth may be regarded as a complicating agency of importance in certain cases. As regards special diseases, Diday shows that congenital syphilis develops generally in the first three months of life; ichthyosis may be congenital or show itself between the ages of three and six; eczema is more common during the first five years than at any other period; impetigo contagiosa is a disorder of childhood; ringworm of the scalp is essentially a disease of the young, and so is pediculosis capillitii; pemphigus is not infrequently encountered in children; and lupus vulgaris usually begins early in life. On the other hand, by way of contrast, it may be stated that acne is rare before puberty; tinea versicolor is an affection of the adult; epithelioma is uncommon before the fortieth year, and children rarely have essential pruritus. These comparisons might be much extended, but enough has been shown for practical purposes.[2]

In this article, owing to necessary limitations of space, only those disorders of the skin most common to children will be considered at any length; rare diseases, or those whose nosological positions are still uncertain, will not be noticed at all or only in the briefest manner.

[1] In the preparation of this article the writer is under especial obligations to the papers on dermatology by various authors in Keating's *Cyclopædia of the Diseases of Children*, and to Crocker's *Text-book of Skin Diseases*. Thanks are also due Dr. C. F. Hersman for much valuable assistance.

[2] See writer's article, "Locality and Age in the Diagnosis of Skin Diseases," *St. Louis Clinical Record*, Nov., 1875.

DISORDERS OF THE GLANDS.

SEBACEOUS GLANDS.

SEBORRHŒA.

SEBORRHŒA is a functional disease of the sebaceous glands, characterized by excessive secretion, which is discharged upon the integument in the form of oily, scaly, or crusted material. There are two varieties—viz. *seborrhœa oleosa* and *seborrhœa sicca;* in the first condition the secretion is fluid or oily, and in the second it is dry and scaly. As the *vernix caseosa* of the new-born it may be regarded as physiological. Both forms of seborrhœa may be present in the same patient, or, on the other hand, the distinction between them may be hard to define. The disease may be present on any part of the body save the palms and soles. A slight amount of seborrhœa of the scalp is often seen during the first month of infancy, and the frantic efforts to get rid of this almost normal secretion frequently leads to an annoying and rebellious eczema. Sometimes the secretion forms a thick crust and extends over the forehead and adjacent parts. Unless the skin has become irritated by the decomposition of the secretion, it will be found cool and even paler than normal. In older children both the dry form, the so-called pityriasis capitis, and the oily variety are not infrequently observed, and, as in the adult, give rise to a dry, lack-lustre state of the hair or comparative baldness.

According to Crocker, the disease is often seen in strumous children in the form of small shining scales situated upon the trunk and limbs, and generally coexisting with lichen scrofulosis. Excessive secretion of sebum at the umbilicus, on the glans penis, the inner surface of the prepuce, and the sulcus in the male, and about the labia and clitoris in the female, is common in ill-cared-for children, and as a consequence of decomposition produces a most sickening odor and sets up an acute dermatitis. Hebra and others regard ichthyosis congenita as a seborrhœa.

Under the term seborrhœal eczema Unna includes not only the dry seborrhœa of the body (lichen circumscriptus) common to adults, but those forms of eczema in children situated upon the eyelashes and other regions. This question cannot be discussed here, but it is proper to remark, as long since pointed out by Kaposi, that seborrhœa is a very common provocative of eczema, and that, therefore, the latter disorder is often encountered in regions richly supplied with oil-glands.

Etiology.—Among the common causes of seborrhœa in children may be mentioned various disorders of nutrition arising from struma, anæmia, gastric and intestinal disorders, and, more directly, inattention to personal hygiene. Unna regards seborrhœa as an inflammatory affection of the sweat-glands, and Brooke thinks it is of parasitic origin.

If long continued, the glands are apt to undergo atrophy, but in the beginning the disorder is purely functional. The secretion, examined microscopically, is seen to consist of epithelial scales, amorphous granular material, and free oil-globules and fat.

Diagnosis.—This offers few difficulties. On the scalp the disease is differentiated from eczema by the absence of marked itching and infiltration of the skin and by the greasy character of the scales. The scales in psoriasis are not greasy, but dry, and are arranged in more or less isolated mortar-like heaps scattered over the scalp. Oily seborrhœa of the body is easily recognized: the dry form should be differentiated from eczema, psoriasis, ringworm, and pityriasis rosea. (See articles on these diseases.)

Prognosis.—Infantile seborrhœa is usually very amenable to proper treatment.

Treatment.—The internal treatment is entirely symptomatic, and consists in the removal of any apparent derangement of the health. Minute doses of sulphide of calcium have been recommended, but the writer has seen no benefit from its use. Mothers should be warned against the fine-toothed comb and other harsh measures in their efforts to cleanse the heads of their babies. Instead, the crusts should be soaked off with free applications of olive oil, and then kept clean with Eichoff's superfatted thymol soap; but if the skin is at all tender, it is better to keep the parts anointed with a little vaseline for a short while. Seborrhœa of the body is managed in the same general way, but if the secretion is persistent—and this holds equally good for the scalp—it is well to apply once or twice daily the following ointment:

℞. Sulphuris præcip. . . . . gr. x–xx.
Acidi salicylici . . . . . gr. v–x.
Vaselini . . . . . ℥j.—M.
Sig. Local use. To be further diluted if too active.

Resorcin, carbolic acid, white precipitate, and tannin are also good remedies.

Seborrhœa of the umbilicus and of the genitals requires absolute cleanliness and the local application of alum or tannin washes. In all cases, if the disease has set up much dermatitis, soothing and antipruritic treatment will be required. (See Eczema.)

Comedo.

Comedo is a disorder of the sebaceous glands in which their excretory ducts are plugged with inspissated sebum mixed with epithelial cells. These so-called flesh-worms or black-heads are generally slightly elevated, pinpoint to pinhead in size, and can be expressed as a filiform mass when pressure is made at the sides of the lesions. Sometimes the comedo is slightly depressed, and, instead of the usual black color, may have a yellowish or even bluish tint. The usual seats of comedones are the face, neck, chest, and back.

Ordinarily, comedones are not seen before puberty; but some years ago Crocker called attention to cases occurring in the children of the poor in summer. According to this observer, they appear on the upper part of the forehead and corresponding parts of the occiput in boys above three years, on the temples in girls, and on the cheeks in infants. They are densely packed and often grouped, and accompanied by seborrhœa of the scalp. Warmth and moisture seem to be the exciting causes. T. C. Fox has made similar observations.

Treatment.—Cleanliness and the free use of soap and water are all that is required in the way of preventive treatment. To remove the comedones when present, friction with a green-soap lather is usually efficacious:

℞. Saponis olivæ præp., vel saponis viridis . . . ℥j.
Alcoholis . . . . . f℥j.
Aquæ . . . . . q.s. ad f℥iv.—M.
Sig. Apply with flannel rag.

In some cases it may be necessary to express the plugs with a comedo-extractor.

Acne.

Although Chambord and others have reported a few cases of acne in young children, practically the disorder does not make its appearance until puberty. The acne due to the ingestion of the iodides and bromides and to the use of tar is not a true form of the disease.

Milium.

Milia are small white or yellowish papules, varying in size from a pinhead to a split pea, that occur for the most part under the eyes, on the forehead, and over the cheeks. It is a tolerably common affection in infants, and constitutes the *strophulus albidus* of Willan.

Etiology.—The etiology is not always clear when occurring in infancy. Milia are often congenital. They also follow in the wake of other diseases—namely, pemphigus, lupus, erysipelas, etc. They are usually regarded as due to retention in one or several of the acini of an oil-gland, but Robinson thinks that two causes may be operative in their production: in one instance "it is a case of miscarried embryonic epithelium from a hair-follicle or from the rete," while in milia following pemphigus, lupus, etc., the contents consist of fatty epithelium and cholesterin, the epithelium being often arranged in concentric layers around a central fat-nucleus.

Prognosis.—Favorable.

Treatment.—The electrolytic puncture, as originally suggested by the writer, is not demanded, nor would it be tolerated, in infantile cases. More or less vigorous friction with soap and water is all that is needed.

SWEAT GLANDS.

Hyperidrosis.

Hyperidrosis is a functional affection of the sweat-glands, giving rise to hypersecretion of their contents. It may be acute or chronic, general or local, limited or excessive in amount. Universal hyperidrosis is usually symptomatic, occurring in connection with acute febrile states or dependent upon general diseases of a debilitating character, such as phthisis, rickets, etc. In the last-named disease, however, the sweating is most abundant about the head. Generally in babies the profuse local and general sweating is induced by injudicious clothing and excessive heating of living apartments, and when these unhygienic conditions are kept up, intertrigo and eczema are not infrequent sequelæ about the genitals and between the folds of the skin. Generalized eruptions of sudamina from the same causes are also encountered.

Hyperidrosis of the palms and soles and axillæ often develops during childhood, and sometimes is clearly congenital and occasionally hereditary; but it does not follow that all of these localities are involved at the same time, for usually the disorder is limited to one region or the other, the palms and soles being more apt to suffer together. When the palms and soles are affected—that is, if the sweating be at all abundant—the skin becomes sodden and macerated, and from the feet the odor is often disgusting. This condition, known as bromidrosis, is more frequent, however, in the adult.

Etiology.—Aside from the more or less physiological sweating due to high temperature, faulty innervation apparently plays the chief rôle in hyperidrosis. Cutler regards it as a functional affection of the sympathetic system. Fœtid perspiration is due to the presence, according to Thin, of the bacterium fœtidum.

Prognosis.—Sweating of the feet is more controllable than that of other parts. Upon the whole, the prognosis of hyperidrosis should be guarded.

Treatment.—The treatment of general sweating is based upon the causal indications, and need not be dwelt upon here. The debilitating sweating about the head in children may be much mitigated by directing them to lie on hair pillows instead of the usual feathers. Among specific remedies may be mentioned belladonna, atropine, agaricin, and ergot; but their effect at best is only temporary. Crocker highly extols precipitated sulphur, given in milk, twice a day. If it proves too laxative, it may be combined with the compound chalk-and-cinnamon powders.

The local applications are numerous. Among the most satisfactory are a 1 per cent. solution of quinine in alcohol, belladonna salve or liniment, tannin dissolved in bay rum (gr. viij to f℥iv), salicylic acid in alcohol (℥j–f℥iv), and various dusting powders, composed of zinc, starch, boracic and salicylic acids. For sweating of the hands Pringle recommends pure silicic acid (terra silicea). For foul-smelling perspiration of the feet dusting the stockings with boracic acid is valuable. The following powder, as suggested by Van Harlingen, is to be commended:

℞. Pulv. acidi salicylic. . . . . ℥ij.
Pulv. zinci carb. præcip. . . . . ℥ij.
Pulv. magnesiæ ustæ . . . . . ℥ij.
Pulv. amyli . . . . . ℥vijss.
Pulv. talci . . . . . ℥x.—M.
Sig. Dusting powder.

Hebra's plan, although troublesome, is eminently successful. Briefly, it consists in wrapping the feet and toes, the latter separately, in cloths spread with diachylon ointment, which should be changed twice daily, and the parts rubbed dry before each reapplication. This should be kept up for two weeks, water being absolutely interdicted during the treatment. Strapping the parts evenly and firmly with soap or lead plaster often suffices.

Miliaria.

Miliaria, lichen tropicus, or prickly heat, is an acute inflammatory affection of the sweat-glands, resulting in papular, vesico-papular, vesicular, and even pustular, lesions. It is a very common disorder in young children, and is usually seated upon the trunk, although the face and other parts of the body are also attacked. The subjective symptoms are very annoying, and consist of sensations of intolerable burning and stinging. The rash comes out suddenly, often after profuse sweating, and generally subsides in a few days with slight desquamation; but if the cause is kept up successive crops will appear. According to the lesion present—and this apparently depends upon the intensity of the process—the eruption has been variously designated—viz. *m. vesiculosa* or *rubra* (the "red gum" of the nursery), *m. papulosa* or prickly heat, etc. The non-inflammatory variety is *m. crystallina* or sudamina. Furunculosis and eczema are not infrequent sequelæ of neglected or ill-treated cases.

Etiology.—Intense heat is the common factor, and therefore miliaria is most frequently encountered in summer. Sudamina are noted in connection with states of general debility and in febrile disorders, but also as a consequence of excessive sweating. In sudamina the sweat collects between the deepest laminæ of the horny layer; the sweat-duct is obstructed, with consequent

rupture of the wall and formation of a vesicle. In miliaria there is vascular congestion about the ducts, increased secretion, and more or less effusion into and about the sudoriparous organs.

Diagnosis.—Sudamina are non-inflammatory in character; which fact, taken in connection with the history of the case, will be sufficient for their differentiation from varicella. The lesions of eczema papulosum are larger than those of miliaria papulosa, are more persistent, and the pruritus is more intense. The vesicles of vesicular eczema are more closely set than those of vesicular miliaria; they rupture readily (in miliaria the vesicular contents usually dry up without rupture) and give rise to the peculiar sticky discharge.

Treatment.—In relapsing cases tonics are sometimes demanded, and more especially change of climate. Ordinarily, attention to diet, which should be of a plain, non-stimulating sort, with proper clothing and, at the height of the attack, some mild refrigerant mixture, is all that is required in a general way. Children in summer should be kept well powdered with borated talcum or similar preparation as a preventive measure. During the outbreak the speediest relief is secured from the use of the calamine-and-zinc lotion:

℞. Zinci oxidi . . . . . ℥ss.
Pulv. calaminæ præp. . . . . ℈iv.
Glycerini . . . . . f℥j.
Liq. calcis . . . . . f℥vij.—M.
Sig. Shake and mop on freely.

If the itching be intense, from two to five minims of carbolic acid may be added to each ounce of the mixture.

Anderson's dusting powder is useful:

℞. Pulv. amyli . . . . . ʒvj.
Zinci oxidi . . . . . ʒiss.
Pulv. camphoræ . . . . . ʒss.—M.
Sig. Dusting powder.

INFLAMMATIONS.

Erythema Simplex.

In simple erythema the skin presents variously-sized, diffused or circumscribed, hyperæmic lesions that fade temporarily upon pressure, and are usually without sensible elevation above the surrounding surface. Subjective symptoms are trivial, and consist for the most part of slight burning and tingling, or they may be absent entirely. An altogether unnecessary confusion has enveloped this subject, owing largely, perhaps, to errors in diagnosis, but also, to some degree, it has arisen from the cumbersome and pedantic nomenclature which has been applied to comparatively insignificant differences in the appearances of the lesions. Simple erythema may be conveniently divided into two main classes—namely, idiopathic erythema and symptomatic erythema.

Idiopathic Erythema.

This variety of the disorder is excited by the influence of external irritants acting upon the skin, and passes readily into a true inflammatory state. *Ery-*

thema calorícum is set up by the agency of heat and cold; *erythema traumaticum* arises from pressure, rubbing, etc.; and *erythema venenatum* is produced by the action of animal and vegetable poisons. Two other forms of erythema, both very common in children, are *e. intertrigo* and *e. pernio*, or chilblain.

Erythema Intertrigo.—Intertrigo usually occurs in the groins, in the folds of the neck in fat babies, and wherever, in fact, the skin surfaces come in contact; and it is all the more readily induced by the irritation of the sweat-secretion and by urinary and fæcal discharges. Intertrigo is always at first a simple hyperæmia of the skin, but when neglected the skin becomes hot and tender, the epidermis macerated, a profuse, malodorous, muciparous discharge is present, and in bad cases fissuring, and even ulceration, may occur.

The eruption is very common, at times appearing suddenly, and, under simple treatment, disappearing again as rapidly; but if maltreated it may run a long course. In some instances it is symptomatic of grave internal disorders.

Intertrigo naturally occurs most frequently in summer, but this is by no means the rule with children. Relapses are frequent.

Diagnosis.—Intertrigo is easy to recognize. Tilbury Fox says it is to be distinguished from eczema by the nature of the characteristic discharge, which does not stiffen linen. The erythematous syphilide of infancy is apt to attack, like intertrigo, the buttocks and genital regions; but, aside from the color and the general concomitants of syphilis, the diagnosis is facilitated by remembering that intertrigo confines itself to the region of the diaper; the syphilide runs down toward the heels.

Treatment.—The preventive treatment demands absolute cleanliness, the use of a bland soap (Eichoff's superfatted thymol soap, for example) and a simple dusting powder, such as oxide of zinc and lycopodium (ʒ ij–ʒvj). For the curative treatment it is necessary to keep the parts separated by the interposition of thin layers of absorbent cotton, and to apply some remedy that is both astringent and antiseptic. The following is a good example of a powder:

℞. Thymol . . . . . gr. j.
Pulv. zinci oleatis . . . . . ℥j.—M.
Sig. Dusting powder.

A modification of Lassar's paste serves an excellent purpose, besides thoroughly protecting the surfaces from irritating discharges:

℞. Acidi salicylici . . . . . gr. x.
Bismuthi subnitratis . . . . . .
Amyli . . . . . *āā* ʒiij.
Ung. aq. rosæ . . . . . q. s. ad ℥j.—M.
Sig. Smear gently over the affected parts.

Of late the writer has used Pick's paste with much satisfaction:

℞. Pulv. tragacanthæ . . . . . gr. xv.
Glycerini . . . . . ♏xxiv.
Aquæ . . . . . f℥j.—M.

This makes a transparent adhesive dressing, called by its originator linimentum exsiccans. By adding to it 10 per cent. of oxide of zinc and 1 per cent. of carbolic acid there will result a most admirable preparation.

Erythema Pernio, or Chilblain.—Chilblains are prone to occur in chil-

dren with poor circulation, and especially in weakly, anæmic girls. The lesions consist of erythematous patches of various sizes and shapes, and attack by preference the heels, toes, sides of the feet, fingers, knuckles, ears, and tip of the nose. The spots are light red in the beginning, but later on become bluish-red. The burning and itching that accompany their development are much aggravated by warmth. The surface of the patches in bad cases may vesicate and result in the formation of large blebs, possessing serous or sero-sanguinolent contents; or the parts may become denuded and slough.

Treatment.—The internal treatment is symptomatic, but, as most of the cases occur in the weakly, tonics and general hygienic measures are urgently demanded. Woollen stockings and loose shoes, without elastic sides, are to be preferred, and the habit of "toasting" at fires and registers is to be prohibited. Friction with snow or cold water should be tried in threatening cases, and afterward soothing, somewhat astringent, lotions prescribed, such as the lotion of zinc and calamine. Pick's paste is also useful at this stage. Later, if the erythematous condition has become fully developed, stimulating local treatment becomes necessary.

The unbroken surface may be painted with iodine or with oil of peppermint, pure or diluted. Jackson recommends—

℞. Ol. cajuputi . . . . . .
Liq. ammon. fort. . . . . *āā* f℥ij.
Lin. saponis comp. . . . . f℥iij.—M.
Sig. Local use.

In very chronic patches Pringle recommends painting with a solution of nitrate of silver (gr. xvj) in spirits of nitrous ether (f℥j), or a 5 per cent. solution of salicylic acid in traumaticin. Ulceration and sloughing, when they occur, should be treated on general surgical principles.

Symptomatic Erythema.

The symptomatic erythemata are very numerous and are due to a great variety of causes. It is well for the practitioner to remember that many general diseases—*e. g.* variola, diphtheria, measles, scarlatina, and vaccinia—are often preceded, accompanied, or followed by erythematous rashes. The scarlatiniform rash that is not infrequently seen in connection with septicæmia, the puerperal state, etc. is also, according to Crocker, an accompaniment of malarial disorders in children. However, it is necessary to bear in mind that quinine in susceptible subjects induces an erythematous rash. Various other drugs are capable of evoking congestions of the skin.

Erythema Infantile.—This form of erythema, also called roseola infantilis, is comparatively frequent, and possesses an importance out of proportion to its severity on account of the confusion in diagnosis to which it gives rise. Temporary congestions of the skin are quite common in teething children and in those suffering from alimentary derangements. The eruption is usually roseolous; that is to say, made up of variously sized and shaped patches and blotches having a general resemblance to the rash of measles. Much of what is called "scarlatina" is undoubtedly this symptomatic erythema. Accompanying the eruption there is usually some slight elevation of temperature, together with some redness, without swelling, of the palate and fauces.

This infantile erythema is an ephemeral affair, and its only importance is of a negative sort. The diagnosis, however, is at times difficult to the inex-

perienced. It is to be differentiated from scarlet fever by the fact that in the latter affection there is a high temperature, great heat of skin, glandular engorgement, the characteristic state of the tongue and throat, and the location of the eruption—symptoms that are absent in infantile erythema—while the catarrhal prodromal stage, the fever, the maculo-papular rash on the mucous membranes and the skin, are significant of measles, and not of erythema. Rötheln is manifestly the result of contagion, two or more children in the family perhaps being simultaneously attacked: the glands behind the neck are apt to be swollen, the eruption is less evanescent and is more papular than erythematous.

New-born babies are often attacked with an eruption made up of minute red papules seated on a hyperæmic base, which may be made to fade away under pressure. The back and chest are the usual sites of the rash. It lasts but a few days, and disappears with slight desquamation. The mucous membranes are not involved, and there is no fever.

Treatment.—The internal treatment of the various erythemata is purely symptomatic. A little calamine lotion or a dusting powder is all that is required locally.

Erythema Multiforme.

Erythema multiforme is an exudative affection of the skin in which various erythematous, papular, vesicular, bullous, tubercular, and nodose lesions may appear separately or coincidently. Preceding the outbreak of this eruption, the patient may experience more or less malaise, gastric disturbance, sore throat, rheumatic pains, and fever. Crocker, who has paid much attention to the skin diseases of children, says that the fever and general symptoms are more marked in them than in the adult, the lesions are more severe, and when vesicles form their contents are prone to become purulent and leave cicatrices. However, the lesions are not so apt to be multiform. There are, nevertheless, exceptions to this rule, for often the general symptoms are insignificant, especially when the eruption is limited in extent.

The local subjective symptoms consist mainly of sensations of burning and tingling.

When the disease assumes the erythematous form, the fading of the centre of the patch leaves a ringed appearance that has been called *e. annulare;* or concentric rings, one forming within the other, will leave in their wake, as the effusion becomes absorbed, a variety of different colors, thus justifying the rather fanciful term of *e. iris;* or these advancing rings, meeting others, become broken into various lines, producing *e. gyratum;* or, made up of widely diffused patches with an abrupt and sharply-defined border, it is called *e. marginatum.* As usually seen, however, the disease makes its appearance in the form of discrete or aggregated flat papules, varying in size from a pin-head to a split pea; in color they are bright red or purplish. Often the lesions are considerably larger (*e. tuberculatum*), in which case they have a deeper or violaceous hue that is quite characteristic. Vesicles or bullæ may form in connection with any of the above-mentioned lesions, thus constituting *e. vesiculosum* and *e. bullosum.*

The backs of the hands and feet are common sites of the eruption, particularly for the papular and tubercular types; but the whole surface is often involved. Slight desquamation and pigmentation may occur as sequelæ. The usual duration of the disorder is from two to four weeks; but the general symptoms usually abate at the appearance of the eruption. Relapses are common, especially in the spring, and in a few rare instances, reported by Fox,

Jackson, and the writer, the disease has relapsed at irregular periods for many years.

Many authorities look upon erythema iris and erythema nodosum as independent affections, but the writer regards them as clearly allied to, if not identical with, erythema multiforme.

Herpes Iris.—It is usually symmetrical, and occurs preferentially on the backs of the hands and feet, but especially the former. There may be one or more patches; sometimes the whole body is affected, even the mucous membranes. The eruption consists of an erythematous base, upon which is seated a conical vesicle; both vesicle and areola increase in diameter, and presently the outer border of the latter is elevated into an annular ring by fresh effusions, while the central vesicle undergoes absorption and leaves in its stead a purplish stain. Here the process may terminate, or else successive rings may form, and the various shades of color thus produced give the rather fanciful rainbow effect. Various other modifications have been noted.

Erythema Nodosum.—Before the eruption is developed the patient may complain of the general symptoms observed in connection with other types of e. multiforme. The lesions consist of isolated, painful, inflammatory nodes that vary in size from a hickory-nut to an egg or orange. They are usually red at first, but as they decline take on the various shades of a common bruise. They may be well or ill defined, and are at first hard and tense, but later become softer, thus closely simulating abscesses. The favorite site of the eruption is the front of the legs, but it may appear elsewhere. Sensations of burning and tingling are usually present. The disorder may last two to four weeks. Relapses are not infrequent.

Etiology.—The various types of erythema multiforme avoid the extremes of life as a rule; the ages between ten and thirty are most obnoxious to its attacks. It seems to occur as the result of the most diverse causes—*e. g.* changes of temperature, disorders of digestion, as sequelæ of vaccination, in connection with epidemic influenza (*la grippe*); and, as regards e. nodosum, it apparently bears some etiological relationship to rheumatism. The explanation would seem to be that these various erythemata are of angeio-neurotic origin, and that under favoring conditions toxic and other agents influencing the central nervous system produce these explosions in the vascular and nervous organs of the skin.

The rash is undoubtedly due to a vaso-motor disturbance, inducing the usual phenomena of inflammation, with a variable amount of exudation. Hæmorrhage into the lesions also occurs.

Diagnosis.—Erythema multiforme is to be distinguished from urticaria by the stability of the eruption, the greater variety of the eruptive elements, and the less degree of itching. The papules of papular eczema are smaller, more pointed, last longer, and are intolerably pruritic. The nodes of syphilis should not be confounded with e. nodosum. Attention to the history of the case, the possibility of ulceration, and other concomitants of syphilis should sufficiently emphasize the differences.

Prognosis.—In the majority of cases the prognosis is favorable. Under no circumstances is the disease dangerous to life, but the relapses are not always easy to control.

Treatment.—The prodromic symptoms of erythema multiforme should be treated on general principles. There is no specific remedy for the disease as a whole. Hygienic measures and tonics are demanded in the anæmic and strumous. In rheumatic cases the salicylates are indicated. The calamine-and-zinc lotion, with or without the addition of a little carbolic acid, is a good local

application. In e. nodosum the legs should be kept elevated, and the same lotion applied, or a lead-and-opium wash. For e. tuberculatum of the hands the unguentum vaselini plumbicum (see under Eczema), spread on muslin and neatly bound, gives relief.

Relapsing Scarlatiniform Erythema (Fereol).

Under the title of "erythème scarlatiniforme desquamatif récidivant" Fereol and Besnier describe a form of disease that occurs in children and young adults, and which really should be discussed along with the other varieties of exfoliative dermatitis. Usually, after a prodromic stage of one or two days, in which the patient feels unwell and has slight fever, a scarlatiniform erythema appears, first on the trunk, and in a few hours, or perhaps not for a couple of days, it spreads over the whole body. In some cases the rash is localized to particular parts of the surface, or it may be widely diffused, but with areas of normal skin between the patches. The oral mucous membranes are also injected. There is some burning and itching present, but the skin remains supple and shows no infiltration. After a few days—one or two—the process comes to an end, and free desquamation occurs. At the end of a week or two the disease has generally run its course; on the other hand, there may be repeated recrudescences and the disorder may be kept up for weeks. Relapses are frequent, especially after vicissitudes of weather or from other general or local exciting causes. It is non-contagious and does not occur epidemically.

Diagnosis.—The distinction between this affection and scarlatina is at times difficult; but in scarlet fever the prodromic symptoms are usually more severe, the eruption comes out first on the neck, chest, and flexures of the joints, the fauces are tumid, the tongue has the strawberry-like appearance, the glands at the angles of the jaw are swollen, and, finally, desquamation does not occur nearly so soon. As additional points it may be remembered that this disorder usually gives the history of relapses, and that it is neither due to nor causes contagion.

Treatment.—This should be directed toward the mitigation of the general and local symptoms—namely, antipyretics and soothing inunctions.

Eczema.

Eczema is an inflammatory, non-contagious disease of the skin, characterized by multiformity of lesion and the presence, in varying degrees, of itching, infiltration, and discharge. It may be acute, subacute, or chronic, and undergoes various secondary changes, such as scaling, crusting, fissuring, and dense thickening of the skin. It was formerly held that eczema was invariably a vesicular disease, and that, therefore, the other types which it presents represented other diseases, such as impetigo, lichen, etc. We now fully recognize the fact that it is a truly protean affection in its manifestations, although possessing a pathological unity in its essential features that is unmistakable. This view has been very fruitful from the standpoints of diagnosis and treatment. So far from eczema being a vesicular disease, it may run its course without the appearance of a single vesicle. On the contrary, the disorder is characterized by a polymorphous eruption, consisting of erythema, papules, vesicles, and pustules. All of these lesions are not necessarily present at the same time, although to a limited extent they may be, and one form of elementary eruption may become transformed into another; but, as a rule, one or another of them may so predominate as to establish the anatomical general

type of the eczema; as, for example, *eczema erythematosum*, *e. papulosum*, *e. vesiculosum*, *e. pustulosum*.

In practice, however, the disease is more often encountered in its subacute or chronic phases, and a brief consideration of these secondary changes will be necessary.

Eczema rubrum or *madidans* may develop out of any of the elementary types of the disease, and consists of a raw, red, and weeping surface, the result of exposure of the rete, due to shedding of the upper layers of the epithelium. The itching is very severe. This form of eczema is common on the faces of children. Scaly or squamous eczema may also follow upon any of the elementary forms of the disease. It appears mostly in patches of variable size, which are red, scaly, and infiltrated; and finally, owing largely to situation or duration of the disease, the eczematous surface may become of board-like hardness, or warty, or cracked and fissured.

The chief subjective symptom present in eczema is itching; in fact, it constitutes the disease. The pruritus will vary considerably in degree, sometimes being slight and easily tolerated, or, again, it may be agonizing in its intensity.

Eczema bears a close resemblance to catarrhal states of the mucous membranes, both in its tendency to repeated relapses and, objectively, in its habit of exudation or discharge. This exudation has the property of stiffening and slightly staining linen or cotton fabrics with which it comes in contact. It is not correct to assert that eczema is invariably a "wet disease," for some cases may remain dry throughout; nevertheless, even a papular or erythematous eczema may be made to weep through the influence of scratching or other irritation.

Although eczema in children, especially in those under five years, is a very common disease, the writer fails to see wherein it differs essentially from the same disorder occurring in the adult, although this opinion is one very commonly entertained. Such differences as exist are rather of causation and location than in clinical expression. In a general way, it may be said that eczema occupies certain situations more often in the child than in the adult—the scalp and face, for example—and that the eruption is more acute, of a more inflammatory type. All of the elementary lesions of the disease—*e. g.* erythema, papules, vesicles, and pustules—are seen in children, and often a commingling of them all, although it must be allowed that pustular eczema is of more frequent occurrence in children than in adults. Eczema rubrum and eczema squamosum are frequent, but leathery-like infiltration is relatively uncommon.

Among other features of importance connected with infantile eczema may be noted secondary glandular swellings, cutaneous abscesses, particularly in the scalps of ill-nourished, strumous children, and post-eczematous furunculosis. The implication of the lymphatics, those in the neck being principally involved, as a result of eczema capitis, was formerly regarded as a sure indication of scrofula; and in eczema occurring after vaccination, with coincident glandular swelling, it was held as proof positive of the introduction of struma by the inoculated lymph. As a matter of fact, this adenitis is purely sympathetic, and is more apt to occur from the irritation set up by pediculi. It is exceptional for the glands to suppurate.

A brief summary of some of the more characteristic features of the eczema of children will now be appropriate.

Generalized eczema is uncommon in childhood, although there may be present, scattered over the body and limbs, infiltrated patches of variable size, sometimes scaly or composed of aggregated papules exhibiting moist and exco-

riated surfaces. The disease also attacks the hands, feet, and legs and the flexures of the joints. Eczema intertrigo, or that form of the disease found in the groin and between other opposing surfaces of skin, is frequent, but not attended with much itching. The surfaces are very red and moist, and are apt to emit a most disagreeable odor; moreover, the eruption may spread from these localities to the contiguous portions of the thighs, back, and abdomen. The writer's experience is in agreement with that of Bulkley in regarding the face as the region most frequently first affected. The primary lesions are usually papules, which run together to form exuding, reddened and crusted patches that are intolerably itchy. In this situation the disease is more prone to relapse than elsewhere, as every varying condition of the system is promptly reflected upon a part especially rich in its vascular and nervous supply. A very common starting-point also is the scalp, where it is often evoked by the nurse or mother in the effort to clear away the sebaceous secretion that clings to the new-born infant. From this region it may spread to the forehead, ears, and face, and the well-known picture of the typical crusta lactea, or milk crust, is presented. The itching is excessive, and the little sufferers, if old enough, make frantic efforts to get relief by scratching; while infants will rub the face and head against the pillow or the mother's breast. In neglected cases eczema rubrum is soon developed.

Etiology.—Eczema is one of the most common of all skin diseases, and it is most frequent during childhood.[1] Even within this period—nay, up to the tenth year—the disease is most frequently developed during the first five years, and, according to Crocker's statistics, one-third of all cases in children begin within the first year of life.

Leaving out of consideration for the present the essential nature of the eczematous process, it may be said that eczema is a catarrhal inflammation of the skin, which may be evoked by a great number of exciting agencies, both internal and external. With children these influences are often sufficiently obvious.

It is not uncommon to find that eczematous parents have eczematous children, but, nevertheless, the disease is not inherited in the sense that syphilis is; it is rather the transmission of a predisposed and vulnerable skin than the inheritance of a diathesis. The ill-nourished and strumous are especially prone to eczema, particularly of the pustular type, with swollen glands, ciliary blepharitis, and otorrhœa as concomitants: and such children, according to Unna, may subsequently develop local or general tuberculosis.[2] It will be found equally true that depressing influences of all sorts, unhygienic surroundings, insufficient or improper food, both for the child and the nursing mother, may be regarded as causative factors of no slight importance. It is no uncommon thing for eczema to follow in the wake of the eruptive fevers, especially measles, in this latter instance often assuming the form of eczema tarsi. Vaccination is often held responsible for inducing eczema, but so also may the operation of piercing the ears for earrings.

As stated above, various dietetic errors induce the disease by provoking gastric and intestinal disorders. The mother's milk may be of an inferior quality from lack of proper nourishment on her part, or it may be at fault from too great indulgence in rich food and stimulating liquids. Over-feeding

[1] In the writer's practice, out of a total of 6724 cases of skin disease of all classes, there were 2148 patients with eczema, or 31.40 per cent. In 3000 cases of eczema analyzed by Bulkley, 907 occurred during the first ten years of life, and 676 of these were observed in children five years old and under; that is, one-quarter of the whole number could be regarded as infantile.

[2] This latter statement must be taken with many reservations, at least from the standpoint of American experience; for many tubercular children never develop eczema at all, and many children with so-called tuberculous eczema never get tuberculosis.



ECZEMA RUBRUM

is more apt to evoke eczema than under-feeding in children. Very few children are properly fed, and it is no uncommon thing to find very young infants allowed everything that appears on the table. The writer has long maintained that oatmeal is a pernicious food for the eczematously disposed, especially the hastily-cooked article reinforced by rich cream and great quantities of sugar. Jamieson of Edinburgh doubts that oatmeal in itself can initiate an eczema, but he thinks it is quite probable that it can light up an imperfectly cured eczema or perpetuate one already existing, as any other cause of eczema may.

Spoon-fed babies are more apt to develop eczema than those nursed by healthy mothers, but here also it is to be remembered that they are liable to disorders of the alimentary canal.

The local and reflex irritations of the eruption of teeth plays no inconsiderable rôle among the exciting causes of eczema, but to regard teething as the sole cause of the disease is unscientific, and the reassuring advice often given that the disease will recover after teething is frequently not fulfilled.

Any form of external irritant may provoke an eczema—*e. g.*, cold, heat, bad soap, hard water, rough under-garments, etc. Seborrhœa is a prolific source of the disease, and the effort to remove the seborrhœal exudation, especially from the scalp of infants, is perhaps one of the most common causes of the disease in that situation. The agency of micro-organisms is probable, especially in localized forms of the affection where the cutaneous secretions have undergone decomposition.

From the foregoing considerations it will be seen that there is no one cause for eczema. Whatever the essential nature of the disease may be, it is obvious that the eczematous subject has a specially vulnerable and susceptible skin, and that under given conditions the disorder may be evoked by any cause, internal or external, that will arouse this susceptibility.

Diagnosis.—Papular urticaria, the so-called lichen urticatus, bears a general resemblance to papular eczema. In lichen urticatus the papules are larger and more discrete, and the presence of the ordinary urticarial wheal may be detected at some period of the case; moreover, the urticarial papules never run together to form the characteristic scaling, infiltrated, and weeping patch of eczema.

Scabies and eczema are usually confounded by the inexperienced. Both itch severely, and in both multiform lesions may be present; but in scabies contagion can nearly always be made out, the other children in the family or the mother being similarly affected, and the eruption occupies certain preferential localities—namely, between the fingers, the flexor surfaces of the wrists and arms, including the axillæ, the lower part of the trunk, both before and behind, and in older boys the penis. In children of some age the eruption will not be found on the face or feet, but in infants both of those regions may be affected. It is safe to say that a generalized multiform itchy eruption, occupying portions of the body that are normally moist and warm, either from the pressure of garments or from contact of contiguous parts, is almost necessarily scabies. The characteristic burrow, or cuniculus, is more readily demonstrated in the child than in the adult.

Various forms of the syphilide, especially the papular and pustular, are liable to be confounded with eczema. In general it may be said that the specific eruption is most apt to be seen about the mouth, nose, and genitals, and that the individual lesions are larger, less acute in aspect, and of a darker color, besides often presenting a circular arrangement. The weazened appearance of the child, the presence of snuffles, and the discovery of mucous patches are important aids in diagnosis. Moreover, syphilitic eruptions do not itch.

Pediculosis capillitii bears some resemblance to pustular eczema of the scalp, but the dermatitis is usually confined to the occiput, whereas eczema is apt to involve the whole head, and a little search will easily discover the pediculi or their nits.

The possibility of confounding eczema with ringworm and favus should be borne in mind. (See those diseases.)

Treatment.—Before entering upon the subject of treatment it is well to take notice of the opinion still lingering among the laity, and occasionally entertained by physicians, that the cure of the disease may be attended with the most serious consequences. This apprehension—a revival of the old humoralistic theory of peccant humors—both modern science and accumulated experience unite in pronouncing absolutely baseless. Hebra acutely suggested that when the protest against a cure comes from a medical man, it is quite likely that it is due to failure on his part to effect it.

In the matter of internal medication it may be distinctly stated that there are no specifics for the affection. In every instance a searching investigation must be made for possible exciting causes or probable complications. Routine is to be avoided and each case managed on its merits.

It not infrequently happens that the little patient is in apparently perfect general health, the disorder being due to external causes, and no treatment beyond the necessary local applications is demanded. Even in such cases proper attention to diet will prove beneficial, and all the more beneficial if a connection can be established between the eruption and dietetic errors. If the child is being suckled, the mother should abstain from stimulating foods and drinks, but if, on the other hand, she is ill-nourished and anæmic, her condition should receive appropriate attention. As regards the child itself, if old enough to be fed, the strictest attention should be paid to the character of the food and to the time and frequency of meals. The usual stuffing with unwholesome and indigestible food should be strictly forbidden, and the physician will find it wise to write out carefully prepared diet tables. The writer has long been in the habit of using the admirable tables, prepared for different ages, to be found in Dr. Louis Starr's valuable work on the diseases of the digestive organs in children. We would reiterate the statement, already made above, that oatmeal, especially when served with cream and sugar, is harmful to eczematous children. Corn grits with salt and butter are just as nutritious and apparently harmless.

The condition of the alimentary canal must be strictly inquired into, so that constipation, gastric and intestinal catarrhs, or other complicating disorders may receive proper attention. An occasional minute dose of calomel will prove useful in nearly all cases. Anæmic and strumous children, who usually suffer from pustular eczema, are much benefited by the use of iron, particularly the syrup of the iodide, and some form of cod-liver oil. A favorite and agreeable method of administering the oil is as follows:

℞. Ol. morrhuæ . . . . . f℥iv.
Pancreatini saccharati . . . . . ʒj.
Pulv. acaciæ . . . . . q. s.
Glyceriti hypophosphit. . . . . f℥iv.
Syr. calcis lactophosphatis . . . . . .
Aquæ . . . . . āā f℥iv.
Olei gaultheriæ . . . . . gtt. xxx.—M.

Sig.—From a teaspoonful to a dessert-spoonful, according to age, three times a day, after meals.

The habit of prescribing arsenic in all cases of eczema is almost a matter of routine with most physicians. Notwithstanding excellent authority to the contrary (Wilson, Bulkley), the writer must insist that this is bad practice. The drug should never be given in acute attacks, and its beneficial effects, even in chronic types of the disease, are by no means constant. Its chief value is in the dry and scaly forms of eczema. Before giving arsenic at all, it is absolutely necessary to see that the digestive functions are unimpaired. Children bear relatively larger doses than adults. Erasmus Wilson, who was a great advocate of the employment of arsenic in infantile eczema after a proper eliminative treatment with mercury, recommends two minims of Fowler's solution for a child from a month to a year old, to be repeated three times a day with, or immediately after, meals:

℞. Vini ferri . . . . . f℥ss.
Liq. potassii arsenitis . . . . . ♏xxxij.
Syr. tolutani . . . . . f℥ss.
Aquæ anethi . . . . . f℥j.—M.
Sig. One teaspoonful three times a day.[1]

As a general thing, the various local measures should be sufficient to allay itching and procure sleep, but at times it is necessary to resort to internal medicines. Any form of opium is inadmissible, as it increases the pruritus. Small doses of phenacetin are of value in allaying restlessness, and it appears to have no ill effect on the eruption. Quinine is particularly recommended by Dr. Pye-Smith as an antipruritic—a half grain for a child of one year an hour before bedtime, a grain at two years, and five grains at the age of fifteen. Where a rebellious eczema is probably due to reflex irritation, the result of a tight prepuce, circumcision or other methods of uncovering the glans should be recommended.

The local treatment of eczema is of the utmost importance; perhaps, taking all the facts into consideration, of more importance than any direct internal medication; for, as the writer has expressed it elsewhere, in quite a large number of cases internal remedies are not demanded at all, either because the disease is due to entirely local agencies, or because the internal exciting cause has ceased to be operative, and there remains only the effects, which may be got rid of by topical means.

In order to determine the character and stage of the disease, it is a prerequisite that all scales, crusts, and other secondary products be removed. Poultices should be avoided, as a rule, but free inunctions with a bland oil will generally suffice for this purpose. *The rule that an eczema should never be washed is absolute.* The habit of daily washing eczematous surfaces is pernicious in the extreme, and is the principal reason of the apparent rebelliousness of these cases to treatment. Even after recovery is seemingly established the use of an indifferent soap will speedily provoke an exacerbation.[2] When the eruption is at its height it is better to let the parts go unwashed, or a little warm milk and water will answer the purposes of cleanliness sufficiently.

The principles underlying the local treatment of eczema are in reality very simple. When the disease is acute, soothing remedies should be applied; when subacute, they may be made somewhat astringent; and when the chronic stage

[1] In the writer's judgment such large doses of arsenic as recommended by Wilson should be administered with great caution, if at all.

[2] The best soaps known to the writer are the superfatted kinds made in Germany. Eichoff's thymol, or Kinderseife, is an excellent toilet article.

is established, a suitable degree of stimulation is demanded. Some few of the many topical applications used in eczema will now be described, together with their special indications, and the subject will be concluded with a brief consideration of the regional forms of the disorder.

Lotions.—Sedative and somewhat astringent lotions are useful in acute eczema. Preparations of lime-water and opium and solutions of soda or borax may be employed for this purpose, but the calamine-and-zinc lotion is the most valuable of all such applications. (See Miliaria.) It should be applied by means of cheesecloth cut into strips and bound on with a neat bandage. If the itching be severe, from two to five minims of carbolic acid may be added to each ounce of this mixture.

Lotions of carbolic acid are often indispensable to allay the tormenting pruritus:

℞. Acidi carbolici . . . . . f℥ss.
Glycerini . . . . . ♏x.
Alcoholis . . . . . f℥j.
Aquæ . . . . . q. s. ad f℥iv.—M.
Sig. Local use; apply several times a day.

This may be used alone or in conjunction with other measures.

Chronic infiltrated patches of limited extent may be made to heal under brisk friction with a tar-and-soap solution:

℞. Ol. cadini . . . . . f℥ij.
Saponis viridis . . . . . .
Alcoholis . . . . . *āā* f℥ij.—M.

This may be quickly rubbed in, then washed off with water, and the parts covered over with unguentum vaselini plumbicum spread on cloth. The necessity for such stimulating treatment does not often arise with children.

Powders.—In general acute erythematous eczema and in the forms of the disease found between folds of the skin, powders are sometimes useful, but as a rule other measures serve a better purpose:

℞. Pulv. amyli . . . . . ℥v.
Zinci oxidi . . . . . ℥jss.
Pulv. camphoræ . . . . . ℥ss.—M.
Sig. Dust on with a puff.

℞. Thymol . . . . . gr. j.
Pulv. zinci oleatis . . . . . ℈j.—M.

This is a good formula in mild cases of eczema intertrigo.

Ointments.—Salves are of especial value where there is crusting and exudation, and since most cases are seen by the physician at this stage, it follows that they are more used than all other preparations together. To secure success it is necessary that the ingredients should be fresh and that the ointment should be thoroughly prepared. Soothing salves should always be spread on suitable strips of muslin and bound on the parts, but when stimulation is desired the remedy may be rubbed in with the finger. When it is desired merely to protect the parts with a bland unguent, the unguentum aquæ rosæ is very beneficial: a little bismuth (℥ij–℥j) may be added with advantage. To increase its astringency and to allay pruritus the following combination may be advised:

℞ Bismuthi subnitratis . . . . . ʒiv.
Zinci oxidi . . . . . ʒss.
Acidi carbolici . . . . . ♏ x.
Vaselini . . . . . ℥ij.—M.

A standard preparation of great value is the unguentum vaselini plumbicum:

℞ Emplastri diachyli . . . . . ℥ss.
Vaselini . . . . . ℥ss.—M.

These should be melted together by gentle heat and stirred until cold. In subacute and moderately thickened eczema, and in the pustular form of the disease, there are few better preparations.

In the great majority of cases of eczema in children, as ordinarily encountered—that is to say, cases in the subacute stage with slight infiltration and intense itching—there is nothing comparable to the zinc-and-tar salve:

℞ Zinci oxidi . . . . . ʒj.
Ung. picis liquidæ . . . . . ʒij.
Ung. aquæ rosæ . . . . . ʒij.
Lanolini . . . . . ʒiv.—M.
Sig. Local use.

This should be applied on strips of muslin, but, as children will not usually submit to the face-mask or other bandaging, it does almost as well to smear it on gently with the finger repeatedly during the day and night. To get good results with this ointment it is absolutely essential that the prescription should go to a pharmacist accustomed to the preparation of ointments. Under the use of this ointment, so promptly does it relieve itching, the writer has been enabled in a large measure to abstain from the harsh methods of physical restraint sometimes advocated.[1]

It is a safe rule even in seemingly chronic eczema to commence with one of the milder preparations, but if the case prove obstinate, we may then proceed to more stimulating applications, as follows:

℞ Hydrarg. ammoniati . . . . . gr. x–xv.
Liq. carbonis detergentis . . . . . ♏ xx–f ʒss.
Lanolini . . . . . ʒj.—M.
Sig. Apply two or three times daily.

℞ Ol. rusci . . . . . ʒss–j.
Ung. zinci oxidi . . . . . ʒj.—M.
Sig. To be rubbed into the parts.

[1] Bulkley (*Eczema and its Management*) makes the following sensible remarks on the application of ointments: "The first application of any ointment may be resisted by the child, and may seem not to give relief; but if a suitable application has been selected, and if it is renewed as often as it falls off or is brushed off, relief will soon be obtained, and the child who first resisted the application will shortly crave it. This matter of the constant protection day and night of eczematous surfaces from the irritating action of the air and external contact must be insisted upon, and carried out at all hazards with rigid severity. Attendants will often neglect it, and the application will often be intentionally removed in anticipation of the visit of the physician, or when inconvenient on account of ordinary matters of daily life. A single neglect, for even a short period, followed by scratching and irritation of the skin, can result in more damage than can be repaired by long treatment." It may be added that a single washing of an eczematous skin will be equally injurious.

Pastes.—These preparations are very useful when there is neither too much crusting nor too great infiltration; moreover, they are very valuable when an adhesive and protective application is required, as they are not readily scratched off or washed away by secretions. They find their principal utility in irritable papular and erythematous patches and in eczema intertrigo. Lassar's well-known formula is as follows:

℞. Acidi salicylici . . . . . ʒss.
Zinci oxidi . . . . .
Amyli . . . . . āā ʒvj.
Vaselini . . . . . ℥ij.—M.

A small amount of tar may be added to secure greater stimulation.

This paste is also valuable:

℞. Resorcini . . . . . gr. x–ʒj.
Lanolini . . . . . ʒij.
Vaselini . . . . . ʒij.
Zinci oxidi . . . . .
Pulv. amyli . . . . . āā ʒij.—M.

Pick's linimentum exsiccans may also be mentioned under this head:

℞. Pulv. tragacanth. . . . . gr. xv.
Glycerini . . . . . ♏xxiv.
Aquæ . . . . . f℥j.—M.

The writer is in the habit of adding to this 10 to 15 per cent. of oxide of zinc and 1 per cent. of carbolic acid or 3 to 5 per cent. of tar. Thus combined, this preparation is of the greatest merit, particularly in cases similar to those mentioned as suitable for pastes in general. The various glycerin jellies have been almost entirely discarded in its favor.

Plasters.—The plaster and salve mulls of Unna, made by Beiersdorf of Hamburg, are very beneficial in suitable cases. The salve mulls are made by incorporating the required remedy, such as lead, mercury, zinc etc., with a base made of benzoated suet and lard, and spread on one or both sides of undressed muslin. The plaster mulls are made of gutta-percha faced with some adhesive substance containing the remedy, and backed with muslin. The salve mulls may be used in subacute cases when a fixed dressing is necessary; the plaster mulls are to be employed only when there is considerable infiltration. In these latter cases the writer's modification of Pick's soap plaster does just as well, and is much less expensive:

℞. Empl. plumbi . . . . . ʒxxv.
Pulv. saponis . . . . . ℈iv.
Aquæ . . . . . q. s.
Vaselini . . . . . ʒv.
Camphoræ . . . . . gr. xx.
Acidi salicylici . . . . . gr. x–xx.—M.
Sig. Spread on strips of muslin and change once a day.

This plaster serves an excellent purpose for thickened patches of eczema on the hands and feet.

Paints.—Fixed dressings made with collodion or solution of gutta-percha are of limited range of application, but may occasionally be used to advantage:

℞. Ol. rusci . . . . . ʒss–j.
Collodii, vel liq. gutta-perchæ . . . . . fʒj.—M.
Sig. Apply with camel's-hair pencil.

This may be painted on chronic patches of eczema about the mouth, both to secure the healing effect of the tar and the protective action of collodion or gutta-percha.

Prognosis.—The prognosis of infantile eczema is generally favorable, provided the nature of the disease and the fundamental principles of treatment are thoroughly understood. That it is prone to relapse, like all catarrhal inflammations, when exposed to the manifold exciting causes that are capable of evoking it, must be admitted; but with patience and perseverance, and the hearty co-operation of parents in the general management, the physician is usually rewarded in his efforts. While it is true that the tendency to relapse decreases with age, the assurance often given that the disease will disappear at certain specified periods—for example, at the cessation of dentition—is not borne out by experience. There is a small minority of cases of eczema that almost justifies the term "malignant." In such cases the disease commences in childhood and recurs with greater or less frequency during life. Fortunately, they are rare.

Treatment of the Regional Forms of Eczema.—*Eczema of the Scalp.*—Remove crusts if present, and clip the hair. If the eruption is acute, apply almond or olive oil with 1 per cent. of carbolic or salicylic acid. A bismuth salve (ʒj–ʒj) is also soothing. After subsidence of the inflammatory symptoms the tar-and-zinc ointment (℞. *Zinci oxidi*, ʒj; *Ung. picis liq.*, *Ung. aq. rosæ*, *āā* ʒij; *Lanolini*, ʒiv.—M.) makes the best application. In children with little or no pain the ung. vaselini plumbicum, spread on muslin, is efficacious. For scaly eczema salicylic acid and sulphur give speedy result (℞. *Acidi salicylici*, gr. x; *Sulphuris præcip.*, ʒss; *Vaselini*, ʒj.—M.). If the eczema is secondary to pediculosis, the pediculi and their nits must be first destroyed.

Eczema of the Ears.—The calamine-and-zinc lotion (℞. *Zinci oxidi*, ʒss; *Pulv. calaminæ præp.*, ℈iv; *Glycerini*, fʒj; *Liq. calcis*, fʒvij.—M.) is the most suitable application for acute eczema of the auricle. Strips of cheese-cloth should be wet with this solution and bound over the parts. The unguentum vaselini plumbicum spread on muslin is well adapted for subacute and chronic cases. The cracked, infiltrated condition found behind the ears is frequently cured after a brisk friction with the tincture of green soap (℞. *Saponis viridis*, *Alcoholis*, *āā* ʒiv.—M.), followed by the lead-and-vaseline salve. (The reader is referred to another section of this work for the treatment of eczema of the auditory canal.)

Eczema of the Face.—The calamine-and-zinc lotion affords the best results for very acute erythematous eczema of this region. In children, however, the disease usually begins more insidiously, and when first seen the parts are generally raw and weeping and covered with crusts. These latter may first be removed by oil inunctions or the immediate application of the ung. vaselini plumbicum spread on muslin. This ointment may be continued, or the tar-and-zinc salve above given may be substituted for it, or else used from the beginning. As stated above, this is by far the best application for almost all forms of infantile eczema. Of course the amount of tar may be increased or diminished according to the effect. In slight patches, or toward the end of

a more pronounced case, Pick's paste (see above) with oxide of zinc and tar may be smeared over and allowed to dry on. This makes a valuable protective dressing, which is not readily scratched off. Lassar's paste is also of use under these circumstances. When it is necessary to employ any of the ointments above mentioned, it is best, if the child will allow it, that the muslin strips upon which the salve is spread be kept in place by a light skeleton mask. This is not necessary for the pastes. Chronic infiltrated areas may be treated two or three times a day by working in a little mercurial-and-tar salve (℞. *Hydrarg. ammoniati*, gr. x; *Liq. carbonis deterg.*, ♏xv–f℥ss; *Lanolini*, ℥j.—M.). Eczema about the mouth is slow to heal, owing to the movements of the parts and the trickling of saliva and food over the inflamed surfaces. Here some form of fixed dressing is indicated (℞. *Olei rusci*, ℥ss; *Collodii*, f℥j), or one of the adhesive pastes just mentioned.

Eczema of the Lids.—Eczema of the surface of the lids is usually of the erythematous type, and generally demands soothing measures, such as the ointment of cold cream with a little oxide of zinc added to it. Eczema tarsi occurs mostly in strumous children, and is a common sequela to the eruptive fevers. Internally cod-liver oil and iron are invaluable, and locally the yellow-oxide-of-mercury ointment is especially beneficial (℞. *Hydrarg. oxidi flav.*, gr. ij–viij: *Vaselini*, ℥j.—M.).

Eczema of the Umbilicus.—The disease in this region is often secondary to seborrhœa, and is very intractable. Ung. vaselini plumbicum makes a good application, but it is usually best to add five or ten grains of salicylic acid to each ounce. Unna's diachylon salve mull is also to be advised. Duhring suggests an ointment of oleate of zinc and calomel. Boracic acid is also useful.

Eczema Intertrigo.—As a prophylactic measure infants should be kept well dusted with some bland borated powder in those parts liable to the disorder; that is, in the genital organs, under the neck, and in the axillæ. When the disease has become established, the affected surfaces should be washed as little as possible, and protected with Lassar's paste (℞. *Acidi salicylici*, gr. x; *Zinci oxidi*, *Pulv. amyli*, *āā* ʒij; *Vaselini*, q. s. ad ℥j.—M.). Pick's linimentum exsiccans, with 10 per cent. oxide of zinc and 1 per cent. carbolic acid, is perhaps even better.

Eczema occurring in other regions of the body requires no special description, and should be treated upon the general principles set forth in the foregoing sections of this article.

Lichen Planus.

As ordinarily encountered, lichen planus consists of an eruption of slightly umbilicated, broad, flat, glazed, purplish-red papules with an angular outline. The papules may remain discrete, or they may be arranged in groups, lines, or bands. By coalescence of the lesions, variously sized, elevated, and sharply defined patches decked with thin scales may be formed. The lesions leave in their wake atrophic spots and distinct pigmentation. Pruritus is sometimes slight or it may be very intense.

The eruption is generally bilateral, and the usual sites of predilection are the flexor surfaces of the wrists, flanks, lower part of the abdomen, around the knees, and on the calves. The face is usually exempt. The mucous membranes may also be implicated.

The disease is rare in children, but Crocker describes an infantile form as follows: "The eruption comes out acutely in groups, each papule of which is

sometimes acuminate at first, but the top seems to die down and a scale comes off, leaving a smooth, shining, angular papule, of a brighter red than usual, though it may get a purplish tint subsequently. It may be on the limbs or trunk, or both, is attended with considerable itching, and gets well in a few weeks with the help of a soothing application." Rickets was present in some cases, conjunctivitis and miliaria in others, while still others were in apparent health.

Etiology.—The causes of lichen planus are obscure. In the acute infantile form Crocker thinks that a sudden chill while in a profuse perspiration is the exciting agency.

Diagnosis.—If the characteristic and typical features of the lichen-planus papule be kept in mind, it is not easy to make a mistake in diagnosis. Even when the lesions have run together into patches, a few outlying angular umbilicated papules may be discovered. When, as sometimes happens, the usual papular eruption is accompanied by an acute erythematous rash, the diagnosis must be held in abeyance for the time being.

Prognosis.—Neglected cases are prone to run an indefinite course, but with proper treatment a favorable issue may be expected.

Treatment.—In acute cases attention to diet and gentle laxatives and diuretics may be beneficially prescribed; and locally, calamine-and-zinc lotion, with a little carbolic acid for the itching, will often speedily remove the eruption. In chronic cases Fowler's solution, with or without iron, is of great value. For external application tar in some form is of most benefit. The following lotion does good:

℞. Saponis olivæ præp. . . . . ℥iv.
Olei ruscі . . . . . .
Glycerini . . . . . *āā* f℥j.
Olei rosmarini . . . . . f℥iss.
Alcoholis . . . . . q. s. ad f℥viij.—M.
Sig. Rub in with a piece of flannel.

A weak tar ointment with mercury is also serviceable:

℞. Hydrargyri ammoniati . . . . . gr. x.
Liq. carb. detergentis . . . . . f℥ss.
Lanolini . . . . . ℥j.—M.
Sig. Apply twice daily.

Wilson recommended a bichloride-of-mercury lotion, and Unna extols an ointment of carbolic acid and mercury.

Psoriasis.

Psoriasis is a chronic inflammatory disease of the skin, exhibiting lesions of various sizes having red bases covered with white dry scales. The disorder attacks the extensor surfaces by preference, especially in the neighborhood of the elbows and knees, but it is also found elsewhere on the body, and almost invariably on the hairy scalp. It is almost always symmetrical. The lesions of psoriasis make their first appearance as minute pinhead-sized spots of congestion that are slightly elevated and surrounded by normal integument. The eruption, although discrete, is usually made up of multiple spots, which enlarge peripherally to the size of large or small coins. The papules may then remain

isolated, or they may run together, and in this way form patches of different sizes and shapes, but possessing a general circular arrangement. Various terms are used to designate the manifold shapes and sizes the psoriatic lesion may assume—viz.: *p. punctata*, *p. guttata*, *p. nummularis*, *p. circinata* or *orbicularis*, *p. gyrata*, and *p. diffusa*. Psoriasis nummularis, or the coin-like form, is perhaps the most common variety; but, whatever the shape or the dimension of the lesions, the essential clinical features of the disease remain unaltered. The lesions are infiltrated, and sharply defined against the unaffected skin, and they are covered with shining, mother-of-pearl, imbricated, easily-detached scales, which upon being scraped off show a punctate bleeding surface.

The eruption has no discharge feature, and itching is either entirely absent or very slight. The patches usually disappear by central involution, and in this way rings and segments of circles may form. The eruption upon its disappearance leaves no traces of its previous existence, except that there may be slight pigmentation on the legs. The disorder is rare on the palms and soles, but the nails are usually rough and brittle. The extension of the eruption from the scalp to the forehead in the shape of a band along the border of the hair is quite common. The hair suffers no permanent injury, and even temporary alopecia is unusual. Children rarely suffer from the more pronounced forms of the disease: in them the eruption is mostly discrete, and made up of small lesions rather generally distributed over the body. The elbows, knees, and scalp are the parts commonly first attacked.

Psoriasis is essentially a chronic affection, although at times having an acute aspect. Repeated relapse is the rule; in some cases, indeed, the patient is practically never entirely free of the eruption, but usually longer or shorter periods intervene between the outbreaks. It is, as a rule, worse in winter than in summer. It not infrequently temporarily disappears during the course of acute diseases.

Etiology.—Psoriasis is common to both sexes and to all conditions of life. In this country it represents about 3 per cent. of all cases of skin disease. The disorder makes its first appearance during childhood more frequently than is generally supposed. It is not contagious. In many cases the fact of hereditary transmission is readily established. The disease has been observed in connection with gout and rheumatism, and it may follow in the wake of scarlatina, varicella, and vaccinia. In fact, our knowledge of its essential nature is obscure, and we may assume, as in the case of eczema, that the psoriatic possesses a specially vulnerable skin, and that his disorder may be evoked by a great variety of widely-differing agencies. It may be added that Lang regards psoriasis as due to a special parasite, while Polotebnoff looks upon it as a vaso-motor neurosis. The histological investigations are contradictory.

Diagnosis.—Seborrhœa, eczema, and syphilis are the diseases that bear the closest resemblance to psoriasis. In seborrhœa of the scalp the scales are greasy and yellowish, and not dry and white, as in psoriasis, and the eruption does not take the form of bands and patches, as in the latter disease; moreover, seborrhœa affecting the scalp may be limited to that region, whereas psoriasis of the scalp will occur in connection with the same eruption on the elbows and knees and other parts of the body. Seborrhœa of the body is not necessarily symmetrical, and is found particularly about the sternal and interscapular region, while psoriasis is nearly always symmetrically disposed, and affects the elbows and knees in addition to other parts of the body. The character of the scales is the same as in seborrhœa of the scalp, and they differ altogether from those found in psoriasis.

Scaly or squamous eczema in patches sometimes strongly simulates psoriasis.



PSORIASIS.

(From the Collection of Geo. H. Fox, M. D.)

but the patches of eczema are not symmetrically arranged, occur on the flexor rather than the extensor surfaces, and the scales are light, tenacious, and do not show a punctate bleeding surface when removed; besides, eczema itches markedly, and there is usually a history of discharge.

The scaling syphilides are not unlike psoriasis in a superficial way. The history of the case must always be taken into consideration, and the presence of concomitant symptoms noted. The scales of the squamous syphilide are dirtier-looking and more adherent than in psoriasis, and the patch is usually more infiltrated. Again, the fact that psoriasis is almost always found on the elbows and knees on both sides of the body, and that the syphilide observes no such localization, is to be kept in mind.

Prognosis.—The prognosis as to permanent cure is unfavorable, but it is usually easy to remove the eruption temporarily.

Treatment.—Beyond remedying obvious defects of health and instituting a rational system of diet, the internal treatment of psoriasis in children is mainly restricted to the use of arsenic, which in this disease is of undeniable value. As young children tolerate relatively larger amounts than adults, it may be given in considerable doses without inconvenience. If the patient is anæmic, it may advantageously be combined with iron. (See formula under head of Eczema.) If, however, the eruption is acute, the use of arsenic should be deferred until the disease has assumed a less inflammatory aspect.

Before undertaking the local treatment it is necessary to remove the scales thoroughly from the patches. In recent outbreaks this is best accomplished by means of warm soda baths, followed by inunctions with vaseline. These measures will sometimes alone be sufficient for the removal of the eruption. If the disease has existed for some time, the scales may be taken off by scrubbing with soap and water or by means of friction with salicylic acid and alcohol (ʒj to f ʒiv).

Chrysarobin is by far the most efficacious remedy in psoriasis, but it must be used very cautiously with children, as it sets up so much irritation. When the eruption is sparse the following pigment may be tentatively employed:

R. Chrysarobini . . . . . gr. xx.
Acidi salicylici . . . . . gr. xx.
Liq. gutta-perchæ . . . . . f ʒj.—M.
Sig. Apply with camel's-hair pencil.

This may be painted on every fourth day, a bath being taken at the end of this period and before each reapplication. If this causes too much dermatitis, its use should be intermitted for a season. The chrysarobin is, however, too severe for some skins, and other remedies should be tried. Bulkley recommends the following application:

R. Acidi carbolici . . . . . gr. v.
(vel Resorcini, gr. x).
Bismuthi subnit. . . . . ʒss.
Ung. hydrarg. ammon. . . . . ʒj–ij.
Ung. aq. rosæ . . . . . q. s. ad ʒj.—M.
Sig. To be rubbed into affected parts.

For delicate skins it may need to be made weaker.

Greenough suggests the employment of a tar lotion consisting of equal parts of alcohol, glycerin, and oil of cade. This prescription may also be considerably diluted.

Among other remedies may be mentioned thymol, naphthol, salicylic acid, sulphur, and the mercurials.

Psoriasis of the scalp is best treated with an ointment of tar and mercury:

℞. Hydrarg. ammoniati . . . . . gr. x.
Liq. carbonis detergentis . . . . . ♏xx.
Lanolini . . . . . ʒj.—M.
Sig. Local use.

It is first necessary, however, to remove the scales with a green-soap shampoo, consisting of

℞. Saponis olivæ præp. (Bagoe) . . . .
Spt. odorati . . . . . āā ʒiv.—M.
Sig. Shampoo.

For psoriasis of the face nothing succeeds so well as a salve of white precipitate:

℞. Hydrarg. ammoniati . . . . . gr. x–xx.
Ung. aq. rosæ . . . . . ʒj.—M.
Sig. Local use.

Pemphigus.

Pemphigus is a very rare disorder. It is characterized by the appearance of successive crops of variously-sized blebs. It may be acute or chronic, but as ordinarily encountered it runs a chronic course. It is customary to speak of two principal forms of the disease—viz. *p. vulgaris* and *p. foliaceus*—but the nomenclature is encumbered with an infinite number of sub-varieties, partly dependent upon the clinical appearances of the lesions, and largely also on the imagination of the observers.

Pemphigus Vulgaris.—Constitutional symptoms are rare, but when the eruption is widespread each outbreak may be preceded by a chill. The blebs usually appear first as minute vesicles, but soon reach the maximum dimensions. They are oval or hemispherical, tense, and vary in size from a pea to an orange, but more generally are the diameter of a hazelnut or walnut. They may arise on normal skin, or they are preceded at the point of eruption by a degree of erythema. The contents of the lesions are at first clear, but gradually become turbid, and sometimes even purulent. The life of a bleb is from two to ten days; it rarely ruptures spontaneously, but desiccates with a thin dry crust. After the fall of the crust the site of the bulla shows slight excoriation, and lastly more or less pigmentation.

Pemphigus may occur on any part of the body, but is more frequent on the face, limbs, and trunk. The mucous membranes, including the alimentary and respiratory tracts, may also be attacked. In the mild forms of the disease the eruption may be kept up by successive crops, more or less continuous or markedly intermittent, for weeks or months; but in malignant pemphigus death may ensue in a few weeks.

As to the existence of an acute pemphigus there has been considerable difference of opinion. Undoubtedly there has been much confusion of diagnosis in this regard, and instances of bullous erythema, urticaria, varicella, etc. have been so classified; but the writer has convinced himself, from obser-

vations made in infants' asylums and elsewhere, that an eruption bearing the clinical features of pemphigus and running an acute course really occurs among children. So good an observer as Crocker agrees in this opinion, and says that there are grades of severity in the acute pemphigus of infants, from the mild, usual type to cases in which those attacked die in a few days. On the other hand, many of the so-called cases of pemphigus contagiosa undoubtedly represent varicella bullosa and impetigo contagiosa (Crocker).

Pemphigus foliaceus is rare even in adults, but Jamieson reports a case in a child which followed the ordinary form. In this type of the disease the bullæ are flaccid, with cloudy contents, and display a sticky secretion when their covers are removed. The whole body eventually becomes involved, and after a time, when the bullous stage has passed away, the surface has the appearance of an exfoliative dermatitis.

Etiology.—The disease is equally common in both sexes, and is met with far more frequently in children than in grown persons. Pemphigus has been observed in connection with a variety of different conditions, such as diseases of the nervous system, disorders of nutrition, after local injury, etc. It also occurs in the apparently healthy. An hereditary tendency to the malady has been noted, and septic influences recognized. Morbid changes in the cord and the peripheral nerves have been discovered in some cases.

Diagnosis.—The mere occurrence of blebs does not constitute pemphigus, for lesions of this character are encountered in erythema, erysipelas, scabies, syphilis, urticaria, and as the result of traumatism; but in all these instances the history of the case and the concomitant symptoms will usually establish the points of difference.

Prognosis.—The prognosis must be guarded, as it is difficult to forecast the ultimate outcome of any case; still, in children at least and in the more acute forms, a favorable termination may be expected.

Treatment.—In acute pemphigus an endeavor should be made to discover the exciting cause or causes of the disease, and to meet such complications as may arise in its course. In the chronic form of the disorder the strength should be maintained by suitable nourishment. So far as direct medication is concerned, arsenic is the chief reliance. It should be given in full doses, freely diluted and frequently administered. According to Bulkley, the quantity of the drug should be fearlessly increased until the disease yields or until it causes diarrhœa or other evidences of disagreement. Opium, an excellent remedy in itself for pemphigus, according to Hutchinson, may be combined with the arsenic, or, if the latter is not tolerated, it may be given alone. Fowler's solution and the deodorized tincture of opium are the best preparations of the respective remedies.

Locally, the tense blebs may be punctured at their bases, so as to allow their roofs to form a protective covering over the excoriated surfaces beneath. Cloths dipped in lime-water and linseed oil, to which may be added 1 per cent. of carbolic acid, make a good application.

The calamine-and-zinc lotion is sometimes grateful, or a powder of oxide of zinc and lycopodium may be dusted on and covered with cotton wool. Raw surfaces may be dressed with the following salve:

℞. Zinci oxidi . . . . . ℈j.
Ung. aq. rosæ . . . . . ʒij.
Lanolini . . . . . ʒvj.—M.

Two or three drops of carbolic acid may be added to each ounce of this ointment.

Herpes Simplex.

This affection, variously known by the names of herpes facialis, herpes febrilis, fever blisters, and cold-sore, is an acute inflammatory disorder characterized by the eruption of one or more groups of vesicles seated upon reddened bases. The vesicles come out abruptly, usually being preceded by sensations of burning and tingling. Their contents are at first clear, but presently —that is, in a day or two—become puriform, and the lesions dry up into light-brown crusts which show no loss of substance upon being detached. The whole process occupies eight or ten days.

The favorite sites of the eruption are the lips, the angles of the mouth, and anywhere on the face below the forehead. The mucous membranes may also be attacked. Herpes simplex is usually symptomatic of febrile disorders, and is often preceded by chilly sensations; in other cases it is due to gastric disturbances or is produced by local irritation. Repeated recurrence is not an uncommon feature.

Diagnosis.—This offers no difficulties.

Treatment.—Regulation of the diet and appropriate remedies for gastro-intestinal disturbances are demanded in recurrent cases, but if there are no obvious causal indications, small doses of Fowler's solution will probably do good. Herpes symptomatic of general febrile states requires no treatment other than that for the exciting cause. Locally, the vesicles should be protected from rupture, and this is best accomplished by painting them over with flexible collodion or mopping on the calamine-and-zinc lotion.

Herpes Zoster.

Herpes zoster, zona, or shingles, is an inflammatory disease of the skin which is characterized by grouped vesicles seated on reddened bases and following the distribution of cutaneous nerves. Although the eruption most frequently occurs around the trunk in the course of the intercostal nerves, it is well to remember that it may develop anywhere else, so that, for example, according to the anatomical seat of the disorder, it will be designated as *z. capillitii*, *z. frontalis*, *z. ophthalmicus*, *z. nuchæ*, *z. facialis*, etc.

Before the eruption of the vesicles the patient may complain of considerable pain in the part to be attacked, or there may be slight febrile reaction. The lesions vary in size from a pinhead to a split pea, and by the coalescence of one or more vesicles a quite considerable bulla may be formed. Their contents are at first serous, in rare cases hæmorrhagic, but presently become puriform. It is characteristic of herpetic vesicles that they do not rupture spontaneously, but in the course of some ten days to three weeks they desiccate into brown crusts, which, falling off, exhibit a reddened surface and not infrequently slight loss of substance. In children the neuralgic pain may entirely cease when the eruption appears, or in severe attacks it may persist throughout.

In nearly every instance the eruption is unilateral, and but rarely recurs. Zoster is usually a descending interstitial neuritis of the spinal ganglion, but Kaposi points out that it may be of cerebral, spinal, ganglionic, or peripheral origin.

Etiology.—Zoster is very common in young people, and is perhaps most prevalent in the spring and autumn of the year. It is contended by some authorities that this affection should be classed with the acute infectious diseases. Hutchinson thinks that zoster is prone to develop during an arsenical treatment.



HERPES ZOSTER

Diagnosis.—The recognition of an ordinary case of shingles presents no difficulties: the grouped vesicles following the distribution of cutaneous nerves, the neuralgic pain, etc. are sufficiently patent symptoms. There are two points, however, worth remembering—viz. first, that zoster occurs elsewhere than around the trunk; and, secondly, that sometimes there are abortive forms—that is, merely reddened patches or clustered papules that do not become vesicular; but in both instances the grouping and distribution of the eruption are the same, as is also the pain.

Prognosis.—In children the prognosis of zoster is always favorable.

Treatment.—Zoster is an acute self-limited disease, which, however, runs a very variable course, and conclusions as to the value of internal medication in its treatment are, therefore, usually fallacious. It is idle to attempt to abort an attack by remedies in our possession, and such treatment is restricted to the relief of pain. As a rule, children suffer but little inconvenience in this latter regard, and a few appropriate doses of phenacetin at night are all that is required.

Some writers believe that it is possible to limit the amount and duration of the eruption by local measures. Duhring advises a weak galvanic current, and Leloir praises pure alcohol or alcoholic solutions of certain drugs for this purpose:

℞. Alcoholis (90 per cent.) . . . . . f℥j.
Resorcini . . . . . ℥j.—M.

℞. Alcoholis (90 per cent.) . . . . . f℥j.
Menthol . . . . . gr. xv.
Ext. cannabis Indicæ . . . . . gr. xxv.—M.

Pads made of wadding are to be wet with these solutions and frequently applied.

The essential point of treatment is to prevent the vesicles from rupture. Flexible collodion, with or without a little morphia, makes an excellent protective dressing and gives marked relief. Pick's paste, the linimentum exsiccans, is also excellent when made as follows:

℞. Zinci oxidi . . . . . gr. xlviii.
Acidi carbolici . . . . . ♏x.
Tragacanthæ . . . . . gr. xxiv.
Glycerini . . . . . ♏x.
Aquæ . . . . . f℥i.—M.
Sig. Smear gently over the parts, and allow to dry on.

Various bland dusting powders, such as oxide of zinc, corn starch, and rice powder, are also useful. It is well to protect the parts with absorbent cotton and a bandage to prevent friction. Ointments should never be prescribed, as they are prone to macerate the vesicles and thus produce ulceration. Should ulceration occur, it may be treated on general surgical principles. Persistent neuralgia following zoster is very unusual with children, but, should it supervene iron and arsenic may be given internally and galvanism applied locally.

Impetigo Contagiosa.

Impetigo contagiosa is an acute contagious disease of the skin characterized by the appearance of vesico-pustules or bullæ. In some cases the eruption is

preceded by slight fever, but more often this symptom is absent. Crocker is authority for the statement that in the febrile cases the eruption appears in successive groups for about a week, but that when unattended by elevation of

FIG. 1.



Impetigo Contagiosa (after Lesser).

temperature the cutaneous manifestations are more limited, and the course of the affection is less definite.

The lesions begin as small, isolated, acuminate vesicles that slowly increase to the size of a split pea or silver quarter-dollar, that are surrounded for a short time by a slight erythematous halo. The contents, at first serous, soon become sero-purulent, and the fully-formed flat or slightly umbilicated vesico-pustule dries to a thin, straw-colored granular crust. As by this time the erythematous ring around the lesions has faded away, the crusts have the appearance of being "stuck on" (T. Fox). When the crusts drop off the underlying surface is red and has the appearance of a burn, but there is no loss of substance.

Jackson calls attention to another variety of the disease, in which the lesions consist of large blebs of an irregular oval shape and several inches long, but usually other typical forms are found elsewhere.

Impetigo contagiosa is generally seen on the face and hands. The lesions may be discrete or else coalesce into patches. Itching is not marked. The disorder runs no special course; it may last two or three weeks, or by repeated auto-inoculations a considerably longer time.

Etiology.—Children are the usual subjects. It is contagious, and often many children in the same house or neighborhood, especially among the indigent, are simultaneously attacked. The writer has known of dozens of cases in a single poor settlement. It is apt to appear in summer. A number of different fungous elements have been described as occurring in the crusts, but definite results are lacking. By some authorities the affection has been ascribed to pus-inoculation from any source, but the clinical facts do not bear out this con-

tention. Its connection with vaccinia has been remarked, but this is perhaps accidental.

Diagnosis.—The presence of large, generally discrete, slightly umbilicated, non-pruritic vesico-pustules, occurring on the lower part of the face or on the hands, is generally sufficiently distinctive for purposes of diagnosis. Bearing these symptoms in mind, it is usually easy to exclude pustular eczema, chicken-pox, and pemphigus. Even when the lesions have run together into patches, or the large bullous form predominates, a few at least of the more usual vesico-pustules may be found.

Prognosis.—Favorable under proper treatment.

Treatment.—The removal of the eruption is comparatively easy. A weak preparation of mercury generally suffices:

℞. Hydrarg. ammoniati . . . . . gr. x–xv.
Ung. zinci oxidi . . . . . ℥j.—M.
Sig. Apply to lesions after removal of the crusts.

To prevent auto-inoculation it is a good plan to smear boric-acid paste over the intervening skin:

R. Acidi boraci . . . . . ʒss.
Pulv. amyli . . . . . ʒij.
Zinci oxidi . . . . . ʒij.
Vaselini . . . . . q. s. ad ℥j.—M.

Dermatitis Exfoliativa Neonatorum.

Ritter has called attention to a severe form of exfoliative dermatitis that occurs between the second and fifth weeks of life. It is apparently non-contagious and unaccompanied by fever. The affection begins around the mouth as an erythema, and extends to the rest of the body. The surface has the appearance of an extensive burn, and the epidermis exfoliates after some amount of fluid has accumulated beneath it. In some cases the eruption resembles an eczema, in others a pemphigus; or, again, when it is limited, it is dry throughout, and the skin becomes infiltrated and fissured. The whole process lasts about a week. Often it is followed by eczema, furunculosis, and gangrenous processes. Death results in one-half the cases. Ritter regards the disorder as of septic character, while Behrend thinks it is merely a foliaceous pemphigus. The treatment is symptomatic.

Other forms of exfoliative dermatitis may occur in children either as primary or secondary processes, but they are unusual. Relapsing scarlatiniform erythema, which is in reality an acute exfoliative dermatitis, has been already described.

Dermatitis Gangrenosa Infantum.

Gangrene of the skin is not uncommon in strumous and syphilitic children, especially following in the wake of chicken-pox and vaccination, and also developing from simple pustular affections. The disorder varies in intensity: in some instances the gangrenous patches are widespread and numerous, with high temperature and a rapid lethal ending, or, on the other hand, there may be present a series of small pustules, each of which sloughs and leaves a small scar, and the disease may be prolonged indefinitely by successive crops (Pringle). As stated elsewhere, T. C. Fox regards the vari-

cella-prurigo of Hutchinson as in reality a form of urticaria. Secondary gangrene of the skin is comparatively rare in this country, even in the infant asylums, and the writer has never met with a case in private practice.

Treatment.—The general treatment consists in the administration of tonics, such as iron, quinine, and the hypophosphites, with cod-liver oil. Good food and proper hygienic surroundings are essential adjuncts. Locally, it is necessary to employ the usual antiseptic dressings.

Urticaria.

Urticaria, nettlerash, or hives, is characterized by evanescent efflorescences called wheals or pomphi, which come out suddenly, retain their forms for a few minutes or several hours, and as suddenly disappear, leaving no trace behind. The lesions usually vary in size from a pea to the diameter of the finger-nail, or they may be much larger. Wheals are generally oval or circular in shape, but also occur in bands or streaks, and observe no special grouping. They are somewhat elevated above the general surface, are flat, and present a sense of resistance to the touch. They are usually white in the centre and bright-red or pink at the periphery. The mucous membranes may also be attacked. The eruption is accompanied by intense burning, itching, and tingling. There may be considerable febrile disturbance accompanying the outbreak in the skin in acute cases, or there may be a day or two of malaise, with coated tongue and other evidences of indigestion, before the rash appears. Sometimes no deviation from the normal condition can be detected.

The type of the disease most commonly seen in young children is the papular—*urticaria papulosa* or *lichen urticatus*. In these instances, as a result of the inflammatory effusion, a small solid papule remains after the disappearance of the more evanescent wheal. In many cases the urticarial element is not manifest to a casual inspection, and the only visible lesions are white or pale-red miliary, scratched papules, more or less discretely scattered over the surface. The eruption is accompanied by intense itching, usually worse at night. Interspersed among the papules, various crusted and excoriated lesions, the result of scratching, may be detected.

T. C. Fox says that while the usual lesion is papular, it may be vesicular, pustular, or bullous as a result of the evolution of the lesion itself, and not as a secondary result of irritation. He claims, moreover, that Bateman's lichen urticatus, Hutchinson's varicella-prurigo, the infantile prurigo of the English, and many of the papular, vesicular, and pustular rashes following vaccination, should be included as phases of infantile eczema.

In addition to the usual form of the disease just described, several other varieties are observed. The titles are sufficiently descriptive—viz. *urticaria papulosa*, *u. tuberosa*, *u. vesiculosa* or *bullosa*, *u. hæmorrhagica*, and, in cases artificially produced by scratching or other irritation, *u. factitia*.

Etiology.—The exciting causes are very numerous, and may be of central, peripheral, or reflex character, acting upon the vaso-motor system. The wheal is probably brought about by a spasmodic contraction of the capillaries, which in return is followed by relaxation and consequent serous effusion. Among the local causes may be mentioned bites of insects, coarse under-clothing, and, in fact, irritants of any sort.

Gastro-intestinal derangement occupies the first place among the indirect causes of urticaria. Many foods have a bad reputation in this regard, such as oatmeal, buckwheat cakes, pork, pastry, and especially strawberries. Intestinal worms often excite the disease in children. Malaria is known to set up

an intermittent type of the disorder. Many medicines also induce it, especially the preparations of cinchona. While it is true that in dispensary practice the papular urticaria of infancy is often caused by bites of insects and other irritating local influences, the writer believes that the majority of cases are due to gastro-intestinal disturbances the result of injudicious diet.

Diagnosis.—The ordinary type of urticaria is readily recognized. Occasionally, when the eruption occupies the greater part of the body in continuous sheets and with accompanying fever, scarlatina may be suggested; but the history of the case, the absence of the scarlatinal throat implication, and the discovery of isolated urticarial wheals somewhere on the body will usually clear up the diagnosis.

Papular urticaria, especially if commingled with ecthymatous lesions, bears a close likeness to scabies; but the localization of the eruption in the latter disease, the absence of burrows, and the freedom of other members of the same family from a similar eruption furnish sufficient grounds for the distinction.

Prognosis.—The prognosis of the acute cases is favorable if properly managed. Papular urticaria is exceedingly obstinate often lasting for months, but even these cases eventually get well.

Treatment.—In all cases the cause must be assiduously sought out, and, if possible, removed. Acute attacks are generally due to gastric disturbance from injudicious diet, and a brisk emetic, followed by a laxative, will be apt to bring about a speedy recovery. The more persistent attacks, kept up by repeated exacerbations, are rare in children. Above all, the diet must be carefully regulated. Quinine is of much value when malaria is suspected. Phenacetin will often cut short an attack. The usual empirical remedies, such as atropine, ergot, pilocarpine, and salicylate of sodium, are scarcely demanded.

In the chronic papular form it is first necessary to remove all sources of external irritation, and, secondly, to clearly indicate the proper method of diet to be pursued. Constipation should be relieved, and appropriate remedies prescribed for any gastric irregularity that may be present.

There is a great variety of measures recommended for the local treatment. Among the household remedies may be mentioned lotions of soda, vinegar (pure or diluted), and the application of cologne-water or other spirits. The calamine-and-zinc lotion, as previously given, with carbolic acid (gr. ij to f℥i) is especially valuable. Menthol in solution (℥ss–f℥iv) is also a good antipruritic.

In lichen urticatus the same preparations may be employed. Fox recommends the following:

℞. Liq. plumbi subacetatis . . . . . f℥ss.
Liq. carbonis detergentis . . . . . f℥ijss.—M.
Sig. Add a teaspoonful to a pint of water.

The same authority advises a dilute white-precipitate ointment or paste for the pustular form.

Urticaria Pigmentosa.

This is a rare form of disease, only a few cases having been observed in this country. It begins within the first six months of life in the form of wheals that come out suddenly, singly or in numbers. The lesions are brownish-red, split-pea sized tubercles, and in the beginning are surrounded by a delicate pink areola; subsequently, however, they increase in size and assume a buff color.

The course of the disease is chronic, and while the first lesions are undergoing involution new ones are constantly forming, so that all the varied stages

can be seen at the same time. Urticaria pigmentosa affects principally the trunk and neck, then the head, face, and limbs. It may or may not itch. In the pruritic variety factitious urticaria is common. The disease is usually arrested at puberty.

The cause of the affection is unknown, and the treatment purely symptomatic.

Pityriasis Rosea.

Pityriasis rosea is a trivial disorder, its only special importance arising from the liability to confound it with grave affections. It is claimed by some writers that the cutaneous eruption is preceded by some elevation of temperature, but this symptom is by no means constant. Brocq states that he has observed that the more general eruption is preceded by a single patch that makes its appearance about the waist, neck, or arm. The lesions in the beginning are minute pinkish papules, which soon enlarge into circular or oval macules having slightly depressed centres and a defined raised border. They are covered with somewhat greasy yellowish or yellowish-white scales. When the patches, by peripheral extension, have reached a diameter of one-half to three-quarters of an inch, the centre assumes a yellow-parchment hue, while the extending scaly margins are distinctly reddish. The patches may remain discrete, or they may run together and produce irregular gyrate areas: these bizarre outlines are also formed by the central recovery and peripheral extension of the single lesions. The skin is but little thickened, and pruritus is, as a rule, insignificant. The eruption is usually found on the trunk, but it may migrate over the body generally with the exception of exposed parts. Papules, ringed patches, and patches that are undergoing involution may be present at one and the same time. The disorder is self-limited, and tends to spontaneous recovery in from two weeks to two months.

Etiology.—English and continental writers state that this affection principally attacks young children, but this is not true in the writer's experience, although he has been brought much in contact with the skin diseases of infants and young persons. It occurs in quasi-epidemics, especially in the spring and fall, but considerable differences of opinion exist as to its contagiousness, and neither has its parasitic nature been satisfactorily demonstrated.

Diagnosis.—Pityriasis rosea is distinguished from the scaling circinate syphilide by its more inflammatory color and the absence of pigmentation; besides, along with the syphilide would be found other evidences of syphilis. Its resemblance to seborrhœa of the body is superficially close, but in seborrhœa the eruption is usually found only over the sternum and between the shoulders, while in pityriasis rosea it is not so limited; moreover, the scales of seborrhœa are thicker and greasier, and there is often a history of considerable chronicity. Pityriasis rosea differs from ringworm in its wider distribution, the absence of papules, vesicles, or pustules from the borders of the patches, and the absence of the tricophyton fungus in the scales.

Prognosis.—The disease undergoes spontaneous arrest within from a fortnight to two or three months.

Treatment.—Internal treatment is useless; indeed, treatment of any sort is unpromising. The calamine-and-zinc lotion is agreeable when itching is a symptom, and ointments of sulphur and boracic acid may be prescribed. A pigment of salicylic acid has seemed to be serviceable:

℞. Acid. salicylici . . . . . gr. x–xv.
Liq. gutta-perchæ . . . . . f℥j.—M.

Prurigo.

Prurigo is a chronic inflammatory disease of the skin characterized by an eruption of pale papules accompanied by severe itching. This disease begins in infancy, the lesions first consisting of urticarial wheals, to which the papules succeed. The papules are quite small, and, as it were, buried in the skin, so that they are more easily felt than seen; their color is in the beginning that of the surrounding skin, but in time, as the result of scratching, they become of a darker hue. The most noticeable feature of prurigo is the intense itching, which at times becomes unbearable. The disease is most marked upon the extensor aspects of the limbs, while the flexor surfaces, the genitals, the scalp, and the face are rarely attacked.

Various secondary changes in the skin are to be noted, such as infiltration, pigmentation, desquamation, etc. A severe form of the malady (prurigo ferox) is marked by intercurrent attacks of wheals, severe dermatitis, pustulation, scabbing and deep pigmentation, and enlargement of the lymphatic ganglia, especially those of the groin.

In a few cases prurigo directly causes death by the constant worry and loss of sleep, setting up a condition of marasmus; but usually it is not fatal.

Etiology.—By some writers prurigo is regarded as a neurosis of the skin. Others do not admit it is an entity, but think it only a group of symptoms caused by the action of various irritants upon a sensitive skin. Prurigo is mainly found among the poor, who cannot have its earlier manifestations treated. The disease is not so rare in this country as it was at one time supposed, a number of cases having been recently reported by Zeissler.

Diagnosis.—Unless the whole course of the disease be taken into consideration, together with the lesions actually present at any one time, there is danger of confounding prurigo with eczema, scabies, and pediculosis. Careful attention to the history and to the situation of the lesions will usually enable a diagnosis to be made.

Prognosis.—The earlier in a case treatment is begun, the better the chance of cure. In cases of very long standing, though a cure may not be effected, the condition may be much benefited.

Treatment.—The diet should be carefully regulated, all those articles which are calculated to provoke a nettle-rash being eliminated.

The general health will often demand tonics and cod-liver oil. Some cases seem to have improved under arsenic. Bromide of potassium, carbolic acid, cannabis Indica, and the salicylates have been used for their effect upon the itching. Pilocarpine and atropine are both well recommended, but since they act best when given hypodermatically, they are rarely ever used in children.

Locally, bathing in quite warm baths, followed by the inunction of an ointment, will probably yield the best results. The ointment may contain tar, sulphur, naphthol, or salicylic acid in quantities varying with the condition of the patient.

Furunculus.

A furuncle is a circumscribed phlegmonous inflammation occurring about a hair-follicle or a gland of the skin. The appearance of a boil may be preceded by a slight tingling or itching of the skin. In a short time a small red papule will be noticed, which is very sensitive to pressure and is accompanied by a burning sensation. The skin immediately around the papule becomes hard and swollen, and thus a hemispherical nodule is formed, varying in size from a pea to a walnut. The color of the boil itself is a

dull red or purplish, while the skin in the immediate neighborhood is of a brighter red. The furuncle at this stage is firm and hard to the touch, very tender, and accompanied by a dull throbbing pain. Within a week or ten days pus accumulates in the boil, and if it is not opened the skin ruptures, giving exit to a more or less free discharge. Lying in the centre of the furuncle is now exposed the core, a whitish necrotic mass, which if left alone comes away of itself in a few days. As soon as the pus is evacuated the pain in a boil ceases, and when the core has separated the hardness in the surrounding skin gradually disappears, while the small cavity remaining fills by granulation. A scar results, which is at first of a violaceous hue, but in time becomes white. Occasionally a boil stops short of suppuration and resolves: this is known, in popular parlance, as a blind boil.

Furuncles may occur singly, or numbers may be on the body at the same time. In some cases the affection is indefinitely prolonged by the appearance of one crop after another, constituting the condition known as furunculosis. Boils may occur on any part of the body except on the palms and soles. In children they are common on the back, the head, the eyelids, and in the axilla. When a boil occurs in a ceruminous gland in the auditory canal, there is great pain on account of the denseness of the tissues in that region.

When boils are single or in small numbers, there is, as a rule, no constitutional disturbance, but in furunculosis appetite and flesh may be lost, while sleep is disturbed by the pain.

A furuncle always commences about a hair-follicle, a sebaceous gland, or a sweat-gland. The severe inflammation causes the death of the follicle or gland, which then constitutes the core.

Etiology.—Boils may be the result of local injury, such as bruising or pressure, as on the buttocks from prolonged sitting. They often occur in depraved conditions of health, as after scarlatina or measles. In summer they often accompany prickly heat. Boils are contagious under certain conditions, such as sleeping in the same bed with a person affected. They may arise during the course of any pruritic disease, probably from inoculation of the skin by scratching. The pus from a boil will produce other boils if inoculated upon another part of the body or upon another person. The virus may be carried from one person to another by flies. These facts, together with the observation that pus-cocci are always found in boils, seem to warrant the conclusion that the disease is due to the presence of a micro-organism.

Diagnosis.—The only disease of infancy with which furuncle is apt to be confounded is that rare syphiloderm described by Barlow, in which several circumscribed abscesses in the skin occur; but here the inflammatory symptoms will be less severe, other symptoms of syphilis will be present, while the abscesses possess no core. In children carbuncle is a rare affection, and can be differentiated from furuncle by the fact that it has several centres of suppuration, which in turn become so many openings.

Prognosis.—The prognosis of furunculus is, as a rule, favorable. Whenever suppuration occurs permanent scarring is the result. In furunculosis the prognosis must be guarded, as in some cases successive crops of boils occur in spite of the best-directed therapeutic efforts.

Treatment.—In the treatment of furuncle the first step is to look for and to correct any condition of general health which might act as a predisposing cause. All local conditions which may be presumed to favor the development of boils should be removed.

Various remedies, such as yeast, sulphide of calcium, hypophosphite of sodium, have been advised for internal administration in the treatment of

furuncle, but their effect upon the local condition is, to say the least, problematical. A great many different drugs have been recommended as possessing the power to abort boils: the apex may be cauterized with a solid stick of nitrate of silver; Guigeot advises painting with tincture of iodine till quite a thick layer covers the boil; boric acid in saturated solution may be frequently sprayed upon the affected surface, and by this means some authorities claim excellent results; the following formula is given by Jamieson:

℞. Tr. iodi . . . . . f℥j.
Acidi tannici . . . . . ℥ss.
Pulv. acaciæ . . . . . ℥ss.—M.

This mixture is to be painted upon the boil and the surrounding skin in successive layers, each one being allowed to dry before the next is put on, till a thick coating is obtained. Unna's carbolic-acid-and-mercury plaster will sometimes cause a boil to disappear: a piece of the mull a little larger than the boil, with its centre cut out to avoid pressure on the sensitive apex, should be applied, and renewed every twenty-four hours. Hypodermatic injections into and around the boil, as well as electrolytic puncture, may succeed in arresting the process, but these methods are too painful to be of use in children.

One of the best methods of treating a boil consists in applying a pledget of absorbent cotton saturated with 2½ per cent. carbolic-acid solution, over which is placed a piece of rubber tissue large enough to cover the cotton and a small area of the surrounding skin; even if this does not prevent suppuration, it will be found to give relief.

Poultices in their ordinary forms are to be entirely discarded, as they favor the development of other boils around the ones to which they are applied.

The skin for some distance around a furuncle should be frequently anointed with an antiseptic ointment, to prevent the inoculation of the neighboring hair-follicles. The following is an appropriate formula:

℞. Acidi boraci . . . . . gr. xx.
Zinci oxidi . . . . . ℥ij.
Lanolini . . . . . ℥j.—M.

As soon as pus is collected in a boil a free opening should be made, the cavity washed out with some antiseptic solution, then dusted with iodoform, and an antiseptic dressing applied.

In the treatment of furuncles in the auditory canal, Cholewa recommends inserting into the ear a plug of absorbent cotton which has been moistened with a 20 per cent. solution of menthol in olive oil. Spencer inserts a cotton plug, having first applied to the boil an ointment of extract of arnica, extract of belladonna, and morphine.

HÆMORRHAGES.

Purpura.

The term "purpura" is applied to certain conditions in which hæmorrhages occur in the skin or mucous membranes. The lesions of purpura may be of a bright red or of a livid bluish hue. They do not disappear upon pressure. The individual hæmorrhages vary much in size, and from this fact various names have been applied to them, as petechiæ, where the extravasations occur

in the form of minute points; vibices, where they occur as streaks; ecchymoses, where they occur as larger spots or blotches. At times hæmorrhages are combined with other lesions of the skin; thus we may find blood effused into a papule or a bulla. Occasionally blood finds its way into the sweat-glands, whence it is extruded along with the perspiration, giving to it a hæmorrhagic appearance—hæmatidrosis.

Hæmorrhages occur in the skin under such manifold conditions that any classification upon an etiological basis is impossible. Clinically, three forms are found with sufficient frequency to warrant a description as special diseases. The mildest form in which the affection occurs is known as purpura simplex. The person affected is usually in good health when the disease manifests itself: the lesions appear suddenly upon any part of the body—in children especially about the neck, upper portion of the trunk, and arms. The eruption is commonly made up of petechiæ, though streaks and larger spots may also occur. The hæmorrhages usually remain discrete, and when sufficiently copious may cause a slight elevation of the skin. The duration of the disease is prolonged by the repeated appearance of fresh crops of the lesions. Each crop, as resorption occurs, passes through the different changes in color that we remark in a bruise. There are no subjective symptoms. The condition is most likely to be confounded with flea-bites.

In purpura rheumatica the extravasation of blood into the skin constitutes the most remarkable feature of the disease, and for this reason it is classed among hæmorrhages. The appearance of the skin affection is preceded by malaise; pain in the joints is complained of, and frequently swelling may be detected. After a day or two a petechial eruption shows itself upon the surface. In its general characters this eruption does not differ from the lesions found in purpura simplex, except that there is a tendency to localization about the affected joints. The disorder may be indefinitely prolonged by relapses, and sometimes passes into a condition simulating purpura hæmorrhagica. The heart may become implicated during the course of the malady, with a resulting lesion of the valves. Henoch and Couty have described a form of purpura which occurs most frequently in children, and is characterized by pains in the joints, vomiting and intestinal pain, and a localized œdema of the skin. (See Purpura Hæmorrhagica.) While purpura rheumatica is at its height there is often a moderate rise in temperature.

The most severe form in which purpura occurs is as purpura hæmorrhagica (morbus Werlhofii). In this affection we find, in addition to the phenomena of purpura simplex, bleeding from various mucous membranes and hæmorrhages into various internal organs. The disease may develop suddenly or be preceded by symptoms of an indefinite kind, such as headache, loss of appetite, lassitude, etc. The hæmorrhages into the skin are frequently larger than those found in purpura simplex, and effusion of blood occurs also in the mucous membranes, as indicated by its escape from the mouth, nose, anus, vagina, and urethra. Bleeding occurs also in the parenchyma of the organs, and when the brain is thus affected speedy death may result. The serous cavities often contain blood.

The disease is usually accompanied by a moderate fever. When the amount of blood lost is not large, recovery may follow, but relapses are not uncommon.

For purpura hæmorrhagica as it occurs in the new-born the designation purpura neonatorum has been given. The disease hardly warrants a special description, since it presents symptoms similar to those found in purpura hæmorrhagica, its only point of distinction being that it occurs within the first few days of life.

Etiology.—In those cases in which hæmorrhage into the skin is merely a secondary or symptomatic phenomenon a cause for the affection can often be ascribed. Illustrations of such cases would be the purpura that often occurs with the specific fevers, as measles, scarlatina, and malaria; or where certain drugs, such as quinine or iodide of potassium, have been ingested; or in cases where we may be able to determine some decided obstruction to the blood-current, as some valvular heart trouble; or where a congenital or acquired weakness of the vessel-walls may be supposed to exist, as in hæmophilia, rickets, or syphilis. In those cases in which the effusion of the blood seems to constitute the chief feature of the disease the etiology is far from being definitely determined. In that form which manifests itself in the new-born babe it has been supposed that the violent changes which then occur in the circulation may account for the phenomenon. Of late years the presence of various forms of micro-organisms has been invoked to explain the occurrence of purpura. Petrone injected blood from patients with purpura into rabbits, and produced a general hæmorrhagic state. Letzerich found a bacillus which, injected in pure culture into rabbits, occasioned hæmorrhages. Several other investigators have made somewhat similar observations. Hanot and Luzet found in the body of a fœtus, the mother of which was dead of purpura, streptococci of identical characteristics with those found in the mother. These observations, though as yet too recent to be wholly relied upon, serve to show that there may be certain cases of purpura which are acute, infectious diseases; and this assumption is corroborated by the clinical history in some instances.

Diagnosis.—The diagnosis of purpura rarely presents any difficulty, as the lesions differ from those caused by inflammatory conditions in not disappearing under pressure. A fleabite differs from a petechia in having a central point, indicating its traumatic origin. Scurvy may be distinguished from purpura hæmorrhagica by the fact that it is caused by a diet deficient in vegetables, that it attacks more than one of those so situated, and that in it we find a spongy condition of the gums, loosening of the teeth, and brawny swelling of the limbs.

Prognosis.—Care must be exercised in giving an opinion as to the course and ultimate result even in simple cases of purpura, as the complications which may arise are manifold. As a rule, the simple forms recover, though the attack may be prolonged by relapses. The prognosis in purpura hæmorrhagica is always grave.

Treatment.—Mild cases of purpura will require no special treatment. In all cases rest in bed is of prime importance, as in this way further hæmorrhage is best guarded against. When the hæmorrhages from the mucous cavities threaten danger, an effort should be made to arrest them by means of tampons, hot and cold water, or a spray of perchloride of iron or other astringent. In the way of drugs to be administered internally, turpentine, acetate of lead, dilute sulphuric acid, ergot, and iron have the best reputation. A combination that has proved of service to the writer is the following:

R. Ext. ergotæ fld. . . . . .
Tr. ferri chloridi. . . . . *āā* f℥ss.—M.
Sig. Three to ten drops in water, *t. d.*

In purpura rheumatica the salicylates may benefit the affection of the joints.

HYPERTROPHIES.

Lentigo.

The affection known as lentigo, or freckles, consists in the appearance, mostly upon exposed surfaces, of variously-shaped, usually small, yellow, brownish, or black spots. Freckles are most common on the hands and face, but may occur on covered parts. As a rule, the affection appears in the second decade of life, though Wilson mentions congenital cases. The spots are prone to become darker and more numerous in the summer, while in the winter they may almost disappear. In its pathology a freckle is a circumscribed hyperpigmentation situated in the rete.

Etiology.—Lentigo is rarely seen before the sixth or seventh year. It affects especially those of a light complexion. Exposure to the effects of sunlight is, by universal consent, the most common cause, though, that it is not the only one is shown by the occurrence of freckles on parts not exposed.

Treatment.—Freckles may be temporarily removed by many stimulating ointments and lotions. One of the best of the former is—

℞. Hydrarg. ammoniati . . . . . ʒj.
Bismuthi subnit. . . . . ʒj.
Ung. aq. rosæ . . . . . ʒj.—M.
Sig. Apply at night.

In cases where the pigment is very black, pricking each freckle, very superficially, with a needle attached to the negative pole of the galvanic battery often hastens its disappearance.

Freckles, though they have disappeared, are prone to return under exposure to exciting causes.

Ichthyosis.

Ichthyosis is a congenital disease characterized by dryness and scaliness of the skin, and at times by the development of thickened warty patches. Two principal varieties are described, though their difference is of degree and not of kind. *Ichthyosis simplex* affects the general surface, but is often most marked on the extensor sides of the limbs. Often there is only to be noticed a dryness and scaliness of the skin, with small papules due to an accumulation of horny cells in the hair-follicles. In more severe cases a thickening of the skin exists and painful fissures may occur. Large scales form on the surface, which get to be of a dark color from accumulations of dirt; and from their being somewhat of a diamond shape may give the skin a resemblance to the hide of an alligator. The face, scalp, palms, and flexor surfaces are apt to be but little involved, the disease in these parts manifesting itself as a branny desquamation. The hair is often harsh and without lustre, and the nails rough and brittle. Both sweat and sebaceous matter are deficient in quantity. The condition grows better in summer and worse in winter.

In *ichthyosis hystrix* there is present in localized areas an exaggeration of the condition just described: the skin is rough and bark-like, or may be covered by actual spines, due to a papillary hypertrophy in addition to the thickening of the epidermis. The usual sites for ichthyosis hystrix are the back, the neck, and the extremities. The lesions may be distributed along the course of a nerve. Occasionally ichthyosis is present at birth, but, as a rule, it first manifests itself after some months or even a couple of years.[1]

[1] Sometimes ichthyosis exists at birth, or in the premature; the "harlequin fœtus" of

Though the disease remains through life, the general health is entirely unaffected. The most striking microscopical changes are thickening of the epidermis, with more or less hypertrophy of the papillary layer of the cutis.

Etiology.—The only recognized factor in the etiology of ichthyosis is heredity. It is apt to recur in successive generations of the same family, though this is not always the case.

Diagnosis.—The diagnosis will be easy if the history be considered along with the characteristic appearance of the disease.

Prognosis.—The disease persists through life, but does not show any detrimental effect on the health.

Treatment.—Arsenic and pilocarpine have been recommended, though in the experience of the writer they exert no permanent influence on the malady. The local treatment is of importance, since by it much relief may be given. In mild cases frequent warm baths, followed by inunctions with glycerin or lanoline, suffice. In cases of greater severity it is advisable to use alkaline baths. Duhring recommends that some simple ointment be rubbed on; after this has remained a few hours a hot bath with green soap is given, and then rinsing in simple water, after which ointment is again applied. The following ointment is recommended:

℞. Adipis benzoati . . . . . ℥j.
Glycerini . . . . . ♏xl.
Vaselini . . . . . ℥ss.—M.
Sig. Apply after bathing.

Various authors recommend the following ointment for constant use:

℞. Potassii iodidi . . . . . ℈j.
Glycerini . . . . . ℥j.
Adipis benzoati . . . . . .
Ol. bubuli . . . . . *āā* ℥ss.—M.
Sig. Rub in once a day.

Naphthol in 5 per cent. ointment, with the use of naphthol soap, is advised by Kaposi. Sulphur or ichthyol (one drachm to an ounce of vaseline) may be used as a daily inunction. In ichthyosis hystrix large horny growths must be removed by the knife or other surgical means. Smaller patches may be treated by the application of salicylic-acid plaster mulls, as devised by Unna, or a solution of the same drug in collodion or traumaticin:

℞. Acidi salicylici . . . . . ℥j–℥iss.
Traumaticini . . . . . ℥j.—M.
Sig. Apply every two or three days after removing the application previously made.

Molluscum Epitheliale.

Molluscum epitheliale is a comparatively rare affection. The lesions are from a pinpoint to a pea in size, according to the duration of the disease. They form little tumors, usually sessile, varying in color from white to a decided pink, often semitransparent, resembling wax, and presenting at one point on

English writers. The body is covered with plates of fatty epidermis separated by furrows. If these children are born alive, they succumb in a few days.

the surface a pit or umbilication indicating the situation of a follicle. Through this orifice on firm pressure a milky fluid may be sometimes squeezed. The lesions are generally few in number, and most frequently occur on the face, on the eyelids, cheeks, and chin. They may be found in other regions, as the neck, breast, or genitals. After the tumors have attained their full size they may remain stationary for an indefinite time, or become inflamed and undergo spontaneous cure by suppuration. Subjective symptoms are absent in molluscum epitheliale. As to the anatomical changes present there are various opinions. Virchow considers that the process begins as a hyperplasia of the hair-follicles, while Leloir and Vidal support the older view, that the tumor is the result of changes occurring in sebaceous glands.

Etiology.—The affection is commoner among children than adults. It is without doubt contagious. As to the cause of the malady there is much difference of opinion, Neisser and others believing it to be the result of some form of coccidia; Wickham contending that molluscum epitheliale is a cutaneous psorospermosis; while Piffard is among those who hold that the pathological process at the basis of the disease is a corneous degeneration of the epithelium.

Diagnosis.—No other affection of childhood is apt to be confounded with molluscum epitheliale.

Treatment.—The little tumors may be successfully treated by laying them open with a knife and pressing out the contents; the base should then be touched with nitrate of silver. Electrolysis also may be used in the treatment of molluscum epitheliale, each lesion being transfixed several times by a slender steel needle attached to the negative pole of a galvanic battery. In a few days, if the operation has been successful, the tumors shrivel up, and eventually disappear: if this result is not attained by the first sitting, the operation must be repeated. Jamieson's method of touching each tumor with pure carbolic acid, and then painting over it with flexible collodion, is said to be effective.

Verruca.

Warts represent papillary hypertrophies, and present great variations in appearance: they may be congenital or acquired. They may occur upon any portion of the body in numbers or singly, though exposed surfaces, such as the hands and face, seem their favorite sites. Various names have been applied to the different clinical manifestations of verruca. Verruca vulgaris occurs most often on the hands of children as one or more elevations from a pinhead to a large pea in size, of the natural color of the skin or of a dark hue, with a smooth or rough, shagreen-like surface; verruca digita is usually found on the scalp, and, as the name implies, presents one or more finger-like projections from the skin, caused by an unusual outgrowth of individual papillæ; verruca acuminata is found in such parts as are kept damp and warm and are subject to the irritating influences of discharges, as about the genitals or anus: this wart occurs as a vascular growth, sessile or pedunculated, of a reddish or purplish color, and is frequently accompanied by an offensive purulent discharge. Various other more or less fanciful names have been applied to different forms of warts, but their importance is not sufficient to warrant description here.

No matter how different the outward form of verrucæ may be, microscopically they consist of exaggerated papillary growths covered by epidermis more or less thickened.

Etiology.—The etiology of warts is enveloped in obscurity: some forms



MOLLUSCUM EPITHELIALE

seem to be contagious; and an explanation for this clinical fact is offered by various observers, who have found micro-organisms—sometimes micrococci, sometimes bacilli, sometimes psorosperms—in the affected tissues.

Diagnosis.—The only other disease of childhood with which verruca may be confounded is that rare form of lymphangioma circumscriptum in which the dilated lymph-spaces are covered and concealed by warty growths. Here careful examination will demonstrate that the seeming warts contain lymph-like fluid.

Treatment.—Recently Epsom salts in sufficient doses to cause two or three evacuations a day has been said to bring about rapidly a cure of warts: this is endorsed by good authority, but the writer has had no experience of it.

Where children can be induced to endure the pain, the wart may be caused to disappear by transfixing it one or more times with the needle attached to the negative pole of a galvanic battery.

One of the best topical remedies is a saturated solution of salicylic acid in alcohol painted on once or twice a day; or this formula may be used:

℞. Acidi salicylici . . . . . ʒss.
Collodii . . . . . fʒj.—M.
Sig. Paint on the wart every other day.

Sometimes powders kept dusted over the affected area will bring about a cure; this powder is as good as any:

℞. Pulv. zinci oleatis . . . . . ʒss.
Bismuthi subnit. . . . . ʒss.—M.
Sig. Dust on the part.

Nearly all of the various caustics have been used to remove warts, but the methods mentioned are equally effective and much safer.

Nævus Pigmentosus.

By the term "*nævus pigmentosus*," or mole, is meant a circumscribed deposit of pigment in the skin, which may be congenital or may develop at a later period. The size of moles varies from a pinhead to a bean, and in some instances a large part of the body is involved. The most frequent sites of nævus pigmentosus are the neck, face, and back. The color of moles varies from a light brownish-yellow to black. Hyperpigmentation may be the only pathological condition present, or this may be accompanied by other anatomical changes: these differences in structure have given rise to special names, such as *nævus spilus*, where a simple smooth deposit of pigment exists: *nævus verrucosus*, where the surface is warty and uneven; *nævus pilosus*, where the mole is covered with hairs.

Moles are of importance from a cosmetic point of view, and because, in later years, they may undergo a malignant change. Anatomically, a mole is a collection of pigment in the rete, often accompanied by an increase in the connective tissue of the skin.

Etiology.—No cause for the appearance of nævus pigmentosus has yet been certainly ascertained. The fact that moles sometimes occur scattered along the course of a nerve seems to point to a neurotic origin in some cases.

Prognosis.—Pigmentary nævi persist through life, only rarely disappearing spontaneously. Where practicable, it is best to remove them, because

of the possibility of a cancerous or sarcomatous growth originating from the moles as life advances.

Treatment.—Electrolysis offers the best method of removing moles of ordinary size. A needle attached to the negative pole of a galvanic battery is introduced into the mole at several points till, in the judgment of the operator, a sufficient amount of destruction is accomplished. To avoid scarring it is best not to attempt to complete the removal at one sitting. For the minutiæ of the operation the reader must be referred to works in which the subject is treated more fully, as space is not here afforded. Electrolysis presents advantages in the removal of large nævi, as there is no hæmorrhage, and scarring is less than by most other methods. The operation is, however, tedious, as a number of sittings are required for the larger growths. When time is an element in treatment, excision with the knife gives the most satisfactory results. It is not good practice to attack moles with caustics, as the results are less favorable than by the methods mentioned, while a malignant change may possibly be provoked.

Sclerema Neonatorum.

Sclerema neonatorum manifests itself as an induration and stiffening of the skin in new-born children. The disease may be congenital, but when this is the case the children are usually still-born. More frequently the trouble develops within the first few days of life. The skin of the legs is usually first attacked, and successive portions of the integument are affected till the whole surface has become involved. Occasionally the disease begins in the cheeks and spreads downward. At first the skin is of a whitish, waxy appearance, and feels thick when pinched between the fingers; but as the malady advances a livid hue is developed, and the skin becomes adherent, so that it can no longer be picked up. When the process is fully developed the child lies rigid, with no perceptible motion save that due to its feeble respirations. The joints are not readily flexed, and the child may be picked up by the legs and held out horizontally; the jaws are so stiff that nursing is impossible. The pulse decreases to 60 per minute; the respirations are slow and shallow; and the temperature is below the normal by two or three degrees: under such conditions life cannot long persist, and is generally extinguished in five or six days.

Sclerema neonatorum was until the time of Parrot confused with œdema, which may occur in the new-born from various causes. Parrot makes the essence of the disease a drying up or desiccation of the skin; he denies that there is a true sclerosis. Langer attributes the stiffness of the integument to solidification of the subcutaneous fat; in infants the fat becomes solid at 89.6° F., while in adults this occurs at a temperature lower than 32°F. If by any depressing cause the infant's temperature is sufficiently reduced, the fat solidifies, and sclerema neonatorum is the result.

Etiology.—The disease is most common in those born prematurely. Any conditions which depress the general health, such as congenital heart affections, bronchitis, diarrhœa, exposure to cold, etc., seem to act as predisposing causes.

Diagnosis.—Sclerema neonatorum is distinguished from œdema by the fact that the skin is stiff and unyielding, and that there is no pitting on pressure. (For the differential diagnosis between sclerema neonatorum and scleroderma the reader is referred to the article on the latter subject.)

Prognosis.—The disease is nearly always fatal. Encouragement is, however, offered by the few cases that have recovered.

Treatment.—An effort should be made to bring the temperature of the child to the normal by enveloping it in cotton wool, or, better, by placing it in

an incubator. As nursing is impossible, nourishment must be maintained by other methods. Milk with brandy may be administered per rectum or by means of a catheter passed into the stomach through the nose. Money reports success in two cases by inunctions of mercury.

Scleroderma.

Clinically, scleroderma presents itself as a thickening and induration of the skin. A limited area or the whole surface may be involved.

The disease may occur on any part of the body, but shows a preference for the upper portions—the head, the thorax, or the upper extremities. The malady may come on acutely, and in a few days involve the entire surface; but more commonly the progress is so slow that the person affected does not notice the presence of the disease till the skin is already hard and stiff. Sometimes the real infiltration is preceded by œdema. When fully developed the affected area is to the touch dense, hard, and will not pit on pressure. The skin cannot be picked up from the underlying structures, nor slid about, as in the normal state. The diseased area is usually on the same level with the healthy integument, and passes so gradually into it that no line of demarcation can be seen. Generally, the surface is somewhat paler than normal, though it may be a uniform or mottled brown from increased pigmentation: it is most often smooth and shining, with the markings of the natural skin obliterated, but in some instances it is scaly. Around the border of the area there is sometimes a zone of hyperæmia. The movement of all the parts affected is limited by the rigid skin, so that the face is expressionless, the neck cannot be easily turned, respiration is hindered, and the joints are not readily flexed. Sensation may be increased or diminished, but pressure on the diseased skin is acutely painful. The mucous membranes may become involved, as may also the muscles. Having persisted in this stage for an indefinite time, the affected skin may become normal, or it may pass into the second or atrophic stage. It then becomes thin, parchment-like, of a dull-white color, with telangiectic vessels showing here and there, and is stretched tensely over the underlying structures. The pressure thus caused brings about atrophy of the tissues beneath, so that the face may resemble a skull with only the skin stretched over it, and the limbs seem made up of only skin and bones. Various distortions of the hands and extremities occur, and ulceration over bony prominences is common.

During the course of scleroderma, endocarditis and pericarditis may develop. There is frequently no disturbance in health till the disease has persisted for a long time, when a state of marasmus may appear and death result. In children the disease is prone to run an acute course, and does not so often terminate in atrophy. The denseness of the skin in scleroderma is due to an increase in the connective-tissue elements. The changes are found chiefly in the corium and subcutaneous tissue. There is at times an increase of pigment in the rete. Around the vessels are found masses of cells the exact origin of which is unknown. In a case examined by Méry there was a development of connective tissue in the muscles of the limbs and in the heart.

Etiology.—The cause of scleroderma is not known. Obstruction of the lymph-channels has been suggested, but this remains an hypothesis. Various observers have detected lesions of the central or peripheral nervous system in connection with scleroderma. The disease seems to have followed exposure to cold, and it has been remarked after erysipelas.

Diagnosis.—The only disease of childhood with which the first stage of scleroderma can be confounded is sclerema neonatorum: here the time of

development will suffice to distinguish, as the youngest child in whom scleroderma has been reported was thirteen months old.

In the atrophic stage scleroderma most resembles Kaposi's disease, but the history of scleroderma, which begins as a thickening of the skin, will, in most cases, differentiate it from this affection, which begins with pigmentation and atrophy. (For other points of difference see Kaposi's Disease.)

Prognosis.—It is impossible to give an opinion as to the result when the case is seen in the first stage. When atrophy has occurred it is permanent.

Treatment.—The body should be clothed with flannel, and exposure to cold, which always seems to aggravate, guarded against. The general nutrition should be cared for by a generous diet and the exhibition of cod-liver oil and tonics. Hot baths often give comfort to the patient. The suppleness of the skin may be increased by vigorous inunctions of oil. Massage has seemed of service in some cases. The constant current has been recommended by some authors, and in a circumscribed patch of scleroderma in an adult Brocq used electrolysis with apparent improvement.

Morphœa.

The affection of the skin known by the name "morphœa" is thought by some dermatologists to be only a circumscribed scleroderma. However this may be, the disease presents enough clinical peculiarities to entitle it to a separate description.

The lesions of morphœa consist of variously sized spots, streaks, or bands with sharply-defined borders surrounded by a zone of dilated capillaries, which zone is often of a violet hue. The affected area is frequently of a waxy-white color, so that it has been likened to a piece of old ivory let into the skin, but at times the color may be pinkish, yellow, brown, purple, or even black. The patches are, as a rule, not raised above the level of the surrounding skin. Generally, the surface is smooth and the skin is not adherent to the underlying tissues, so that it may readily be picked up, when it is found to be slightly thickened; sometimes in one part of a patch there exists thickening, while in another the skin is thinner than normal. The disease occurs frequently upon the breast, and may affect any part of the body. Sometimes several patches are grouped along the course of a nerve. At times the disease presents itself as a number of small atrophic pits in the skin.

The subjective symptoms are insignificant, being limited to slight itching. Occasionally, the centre of a patch will be insensitive.

The disease persists for months or years, and then may disappear, leaving the skin normal; or the final result may be an atrophy of the skin, and even deeper structures. Crocker found in the earlier stages of morphœa a considerable infiltration, in the corium, of cells which later become connective tissue, and by their contraction cause atrophy of the blood-vessels and glands.

Etiology.—The disease may occur at any age beyond two years. It is thought by many to be a neurotic affection, and certain facts lend countenance to this belief, as its occurrence with other disturbances of the nervous system, such as hemiatrophia facialis, canities, alopecia areata, etc., and its being often distributed along a nerve-trunk.

Diagnosis.—Leucoderma differs from morphœa in not presenting any alteration in the texture of the skin, there being simply an absence of pigment. The atrophic spots of leprosy show marked anæsthesia, and the concomitant symptoms will aid in the diagnosis. Keloid is more vascular and

denser than morphœa, is redder, and its lesions present the well-known claw-like processes.

Prognosis.—Although morphœa has a tendency toward recovery in the course of time, with no permanent damage to the skin, yet in view of the cases followed by atrophy the prognosis must be somewhat guarded.

Treatment.—No internal medication has any effect on the lesions of morphœa, and thus far local remedies may be said to be equally futile.

ATROPHIES.

Albinism.

Albinism is a congenital absence of pigment: it may be total or partial. When general, not only the skin, but also the hair, the iris, and the choroid lack their normal coloring matters. Persons thus affected are termed albinos, and present the well-known characteristics of a pink skin, white hair, and pink irides. Frequently nystagmus may be observed in albinos, from the irritating effect of the light upon the unsheltered retinæ. These persons are often poorly developed, both physically and mentally. Albinos are quite frequently the offspring of negro parents.

Partial albinism is most common among negroes, and occurs as limited areas in which the pigment of the skin is absent. Should these areas be found in hairy regions, the hair also lacks its coloring matter. In rare cases partial albinism spontaneously recovers by a new deposit of pigment in the affected part.

Leucoderma.

Leucoderma is an acquired diminution of the pigment of the skin. It usually occurs as one or more round or irregular-shaped areas, in which the skin is of a much whiter color than the surrounding integument. Such patches of skin vary in size from a quarter of an inch in diameter up to several inches, and their borders are strongly defined from the healthy skin by a line of abnormally deep pigmentation which surrounds the leucodermic plaque. Hairs growing on the affected areas may be white or may retain their natural color. Save for the absent pigment the diseased skin is quite normal.

Leucoderma is generally symmetrical, and occurs most frequently on the neck, face, backs of the hands, and about the hips. The disease tends to slowly progress, till in the course of time the whole body may become involved. When leucoderma has thus extended over a whole member, it is often thought to have recovered, as the contrast with the healthy skin can no longer be remarked. As a matter of fact, the pigment is rarely if ever restored. The disease appears to grow worse in summer, because at this season the pigment of the normal skin becomes darker.

Etiology.—Leucoderma usually develops between the ages of ten and thirty, though the writer has seen it in a child four years old. Beyond the fact that the malady seems to be due to some disturbance in innervation, nothing is known as to its etiology. It is sometimes secondary to other diseases, such as morphœa, alopecia areata, and eczema.

Diagnosis.—From the congenital absence of pigment known as partial albinism leucoderma is distinguished by its history, its symmetry, and its pro-

gressive tendency. From morphœa it will be differentiated by the fact that in the former disease there is a change in the structure of the skin. From the white spots which occur in nerve-leprosy, leucoderma can be told by the fact that the macules of leprosy are anæsthetic and often scaly.

Prognosis.—There is little hope of recovery, though in time, by the spread of the disease, the effect is rendered less startling.

Treatment.—No drug, either internally or locally, has any effect upon the disease. The most that can be done is to remove the hyperpigmented border and thus relieve the contrast. (For the various means of accomplishing this see Treatment of Lentigo.) Tatooing or staining the patches with walnut-juice may be tried where the cosmetic effect must be cared for.

Alopecia Areata.

Sometimes, after certain premonitory symptoms, such as headache or burning or itching, the hair is lost from the scalp in one or more circumscribed spots; more frequently, however, these sensations are absent, and the patient's attention is first attracted by the peculiar and striking areas of baldness. The patches are usually quite white and perfectly smooth, and give the appearance of slight depression. There may be one or many bald spots, and they may vary in size from a dime-piece to that of the palm, the larger areas usually resulting from coalescence of the smaller ones. Sometimes the loss of hair is general, but this must be rare in children. The disorder runs a chronic course. It may persist from a few months to several years. When recovery sets in, the returning hairs are white and downy, but gradually attain their normal size and color.

Etiology.—The disease is comparatively frequent in children. It is sometimes noted to occur after various illnesses, but more often there is no such history. A blow on the head, or, in the adult, persistent neuralgia, is occasionally apparently responsible for limited areas of the disease. By some authorities it has been regarded as contagious (Hillier and others), but certainly in the majority of instances this is not so, and it is likely that the recorded cases of such character are susceptible of some other explanation. Neither has the parasitic theory been maintained. The writer is in agreement with most dermatologists in looking upon alopecia areata as a trophoneurosis.

Fig. 2.



Alopecia Areata.

Diagnosis.—The disease is so striking that its recognition is a matter of little difficulty. Ringworm of the scalp bears the closest resemblance, but in this latter affection the patches are not smooth and glistening, but are covered with grayish scales, and scattered over the surface are to be seen the stumps of broken-off hairs; besides, if any doubt arise, the microscope will soon settle the question. Favus, syphilis, and certain forms of folliculitis would also be differentiated.

Prognosis.—The alopecia areata of young people generally tends to spon-

taneous recovery, although undoubtedly much hastened by appropriate treatment.

Treatment.—There is no special internal treatment beyond attention to any obvious defects of the general health. In rebellious cases small doses of arsenic might be tried. Locally, the demand is for thorough and persistent stimulation. The following, briskly rubbed in twice a day, is useful:

℞. Acidi salicylic. . . . . ℈j.
Sulphuris præcipitati . . . . . ʒj.
Vaselini . . . . . ʒj.
Olei rosæ . . . . . q. s.—M.

Equal parts of tincture of cantharides and glycerin serve an equally good purpose. Pilocarpine in ointment or the fluid extract of jaborandi in lotion may be advised. Galvanic stimulation with a metallic brush (negative pole) is also to be recommended. In obstinate cases blistering limited regions at a time with cantharidal collodion gives excellent results.

NEW GROWTHS.

Kaposi's Disease.

This disease, which is also known as xeroderma pigmentosum and angioma pigmentosum et atrophicum, develops in the first year of life, frequently as an erythema, upon the disappearance of which small, variously colored pigment-spots, resembling freckles, are noted. Sometimes the pigmentation is the first morbid change observed. In a short time small atrophic spots begin to appear, and as the atrophy advances vascular telangiectases of various sizes develop, which may, in severe instances, form small elevated blood-tumors. Often warty growths are seen arising from the pigmented spots. As the malady progresses the atrophic skin, by contraction, may cause marked deformities. Ulcers are prone to form, and these or the warty growths referred to may be the starting-point for malignant tumors which often terminate the patient's life. The most frequent sites of the malady are those parts which are habitually exposed—the face, neck, hands, and feet.

Kaposi's disease is essentially an atrophy of the skin beginning in the papillary body and epidermis. The tumors which are associated with this process are usually described as epitheliomata, though some observers found papillomata and sarcomata.

Diagnosis.—The atrophic stage of some cases of scleroderma most resembles the disease under consideration, but the history of the two affections is entirely different.

Prognosis.—The prognosis is in all cases bad, for after the malignant growths have once developed the patient has only a few years, at the most, to live.

Treatment.—No internal medication has any effect upon this disease. The ulcers should be treated on general surgical principles, and the tumors removed at as early a date as possible.

Nævus Vascularis.

The affection known as nævus vascularis consists in a congenital new-growth of blood-vessels, which may be manifest at birth or may show itself

at a later period. The clinical picture will vary much according to the size of the vessels involved and the presence or absence of implication of other structures, such as the connective tissue, hair-follicles, or fatty tissue.

As usually seen, nævus vascularis consists of spots of various sizes, in color from a pale red to a bluish hue, not raised above the skin, disappearing largely on pressure, and due to a new formation of capillary vessels. Sometimes there will be only a small pinhead-sized point, radiating from which are numerous red lines (nævus araneus): at other times areas as large as the palm may be involved (port-wine mark). This capillary form of nævus may spontaneously disappear, may remain stationary, or may increase rapidly in size till large areas become involved. According to Depaul, one-third of the children born at the Clinique de la Faculté de Médecine in Paris have this form of birth-mark, but in most cases the mark disappears within a month.

Often over the surface of a capillary nævus warty growths occur, and at times small erectile vascular tumors may be seen. The most common sites for this form of nævus are the face, scalp, neck, arms, and genitals.

When the vascular channels constituting the nævus are of a larger size, we find elevated areas, usually of a bluish color, often lobulated, soft and frequently fluctuating, compressible, but rapidly filling again when pressure is removed. In such tumors pulsation may at times be observed. Nævi of this form seem sometimes to develop from the capillary variety. They vary in size from a pea to an orange, and occasionally attain enormous proportions. In some instances these growths lie entirely in the subcutaneous tissue, the skin being simply stretched over them, but not altered otherwise. Nævi of this kind most often occur on the neck about the lower jaw, on the buttocks, and on the lower limbs.

As a rule, vascular nævi are not accompanied by any subjective symptoms, but in some of the pulsating tumors there are neuralgic pains.

Nævus, especially nævus vascularis, consists of new-formed vessels which are variously distorted, being convoluted or varicose. Sometimes, from pressure, parts of the intervening vascular walls are broken through, and irregular intercommunicating chambers are formed (cavernous tumors of some authors). In connection with the growth of the vessels there may be an increased development of other elements of the skin—connective and fatty tissue, glands, hairs, etc.

Etiology.—Maternal impressions are thought by some to determine the location of nævi, and such views have been supported by many instances. When we consider how common nævus vascularis is, it does not seem strange that there should often be an accidental coincidence of birth-mark in the child and "maternal impression" in the parent.

Diagnosis.—Nævus vascularis cannot readily be confounded with any other affection of the skin, and the diagnosis is easy.

Prognosis.—The prognosis must be guarded. Though small nævi may remain stationary, or may even disappear as the child grows older, on the other hand they often increase rapidly in size, and this may occur after the growth has remained stationary for years: this is especially true of the prominent and pulsating nævi.

Treatment.—For the cure of the elevated or pulsating nævi, when the area involved is of limited extent and a reasonable hope of cure in a few sittings may be entertained, the most satisfactory means is the coagulating effect of electricity. The child must be anæsthetized, as the operation occasions a good deal of pain. A slender steel needle attached to the negative pole of a galvanic battery is thrust into the tumor; the positive sponge electrode is then placed upon some convenient portion of the child's body. The length of time the current should be passed must be determined by the thickness

of the skin and the size of the vessels of the tumor. As coagulation occurs, a paling of the tumor usually follows. The needle must be passed through different parts of the nævus; the number of times will depend upon the size of the growth. A current from twenty to thirty cells of a galvanic battery will suffice. To secure the complete cure a number of sittings will generally be required, and this fact constitutes the principal objection to the method. Some operators plunge needles attached to both the positive and negative poles into the tumor, but the writer prefers the method above described.

When nævi of this class are very large, their treatment must be undertaken by surgical means, a discussion of which is not within the scope of this article.

In the treatment of the superficial nævi, where the affected vessels are capillaries, electrolysis is not so satisfactory, for if the area involved be of any extent, an indefinite number of repetitions of the operation will be required, and, moreover, as the vessels to be destroyed are so small and so numerous, each sitting must be of considerable length; as the operation requires anæsthesia in young children, the number of the sittings and the length of time employed in each become serious objections to its performance.

Unless the birth-mark is very small, other methods will be found more applicable. Ethylate of soda may be painted over the nævus, and when the eschar thus formed has separated the remedy may be reapplied till a cure is effected.

A 4 per cent. solution of corrosive sublimate in collodion is recommended, and it is stated that the resulting cicatrix is thin and smooth.

Pure carbolic acid may be brushed over the nævus; by several applications a cure will usually be effected. A host of other escharotics has been recommended, but those mentioned are among the most reliable.

Multiple puncture and incision, though strongly advocated by some, have failed in the hands of many careful operators.

Lupus Vulgaris.

Lupus vulgaris is a chronic granuloma of the skin, depending upon the presence of the tubercle bacillus. It usually manifests itself in early childhood as small brownish-red spots, which may be a trifle depressed below the skin, on a level with the surface, or even slightly raised. Several such spots are generally noticed in the same neighborhood: as they grow older they increase in size, while at the same time an infiltration of the skin occurs: they are then of a brownish color, semi-transparent, softer than the surrounding tissues, so as to be more readily broken down under pressure, and constitute what is known as lupus tubercles. These tubercles gradually coalesce by peripheral extension to form patches of a brownish-red color, raised at the borders, often depressed in the centre, accompanied by deep and firm infiltration of the skin. The typical lupus tubercles, which have been likened to masses of apple-jelly, though they may not be discoverable in such a patch, may generally be detected about its edges. After remaining in this condition for an indefinite time, one of two processes occurs in the lupus patch: interstitial absorption may take place, producing eventually a shining depressed cicatrix; or the lupus tissue may break down, leaving ulcers of various shapes and depths, often covered with crusts and having raised infiltrated borders. When healing takes place after ulceration the scars are thick and rough.

Various accidental features may present themselves during the course of lupus, which have given rise to a number of special names; thus, if warty

growths are present on the patch, the disease is known as *lupus verrucosus*, if granulations are exuberant, it is *lupus hypertrophicus;* if the borders advance in a sinuous manner, the title *lupus serpiginosus* is given.

Lupus usually occurs on the face about the nose and cheeks, but it may attack any part of the body except the forehead, chin, palms, soles, and penis, which portions of the body seem to be exempt. The mucous membranes may be involved, but this is most often by extension from the adjacent skin. Whole organs or entire regions may ultimately be destroyed by the disease, but the onward progress of lupus is so slow that such ravages are usually not witnessed till the patient is of some age.

The course of the malady is not uniform; at one period it advances with great rapidity, and then for long intervals it may remain quiescent.

Various complications may arise during the course of lupus: when the disease occurs upon the limbs and extremities, the bones may be destroyed by caries; erysipelas sometimes develops in the lupus patch, but often exercises a favorable influence upon the malady; the inflammatory processes accompanying lupus may involve the lymph-vessels, which, becoming obstructed, give rise to a condition resembling elephantiasis.

Microscopically, lupus tissue is made up of a reticulum of fibrous tissue, the meshes of which are filled with round cells and a varying number of giant-cells. Some observers have been able to demonstrate the presence of tubercle bacilli, but they usually occur in such small numbers that their discovery is difficult.

Etiology.—Lupus generally begins in childhood, and is more common in females than in males. It is stated by excellent observers that a tubercular family history may be obtained in a majority of the cases, though comparatively few of those suffering from lupus have consumption. The observations of Koch, Pick, Doutrelepont, and others make it very certain that lupus vulgaris is a tuberculosis of the skin.

Diagnosis.—The history of the case and the presence of the lupus tubercles generally make the diagnosis easy. In children the only disease with which it might be confounded would be a gummatous syphilide, and this is very rare in childhood; when a gumma appears, it goes through its evolutions much more rapidly than lupus, frequently breaking down into a punched-out ulcer with sharp-cut, thin borders, which readily heals under appropriate treatment.

Prognosis.—The progress of lupus is so slow that, save in those rare instances where the disease involves a vital organ, death results more often from some intercurrent trouble than from the disease itself. If neglected, horrible deformities occur, and even in those cases where a cure results from treatment, permanent and disfiguring scarring is left.

The disease justly has the reputation of being very rebellious to treatment. Perhaps one of the chief reasons for this is that treatment to be successful must be so long protracted that the patient becomes discouraged ere it is completed.

Treatment.—Lupus demands both constitutional and local treatment. The child should be given the most nutritious diet; plenty of fresh air and sunshine should be recommended; the sleeping apartment should be well ventilated, and habits of cleanliness insisted upon. The two remedies for internal administration are cod-liver oil and the preparations of iodine. As large doses of the oil should be given as can be borne by the stomach. The iodide of potassium or the syrup of the iodide of iron will be found the most eligible forms for the administration of iodine.

Hypodermatic injections of tuberculin, as proposed by Koch, have not yielded the brilliant results at first expected of the remedy, and the most enthusiastic can now only claim for this method of treatment a very limited field.

The local remedies that have been used in lupus are so many that merely to enumerate them would require more space than can here be given. When a case of lupus is first seen it is often of benefit to apply for a time soothing remedies, as in this way external irritation is removed and it is possible to see what part of the trouble is due to the lupus and what part to accidental inflammatory complications: for this purpose nothing is better than unguentum vaselini plumbicum spread on linen and changed twice a day. With the idea of destroying the tubercle bacilli, any ulcers present may be dusted with iodoform before the ointment is applied.

One of the oldest methods, and still regarded by some as the best, for destroying the lupus growth is by the application of the stick of nitrate of silver: this is of special use in small patches. To be effectual the sharpened point should be bored deeply into the affected tissues.

Pyrogallic acid is one of the remedies most frequently used, and is an efficient caustic: it may be applied in the form of a plaster, for which Duhring's formula is—

℞. Acidi pyrogallic. . . . . ʒij.
Emp. plumbi . . . . . ʒj.
Cerati resinæ comp. . . . . ʒv.—M.
Sig. Apply on cloth.

This plaster should be renewed every twenty-four hours for three days, and then the surface dressed with a simple oil dressing till the eschar is separated. A mild mercurial ointment then forms a most excellent dressing. The procedure may have to be repeated several times before cicatrization is secured.

Hebra's modification of Cosme's paste often produces excellent results. The formula is—

℞. Acidi arseniosi . . . . . gr. xx.
Hydr. sulphuret. rubri . . . . . ʒj.
Ung. aq. rosæ . . . . . ℥j.—M.
Sig. Apply on muslin.

This should be renewed once a day for two or three days: it should never be used on a large surface at a time, for fear of arsenical poisoning.

Unna's salicylic-creasote plaster-mull is highly recommended by some writers: this mull is prepared in strengths varying from 5 to 20 per cent. of salicylic acid, with twice as much creasote; the strength used will depend upon the age of the patient and the amount of infiltration in the lupus patch. A piece of the mull sufficiently large to cover the area which it is desired to attack should be applied each day until enough destruction has been produced; a mild mercurial ointment should be applied on cloth until the healing occurs.

Various surgical procedures have been used in the treatment of lupus. Multiple linear scarification has been much employed in the early stage of the disease, the tissue being minced as finely as possible by numerous cuts made at right angles to each other; but this method of treatment has been largely

superseded by other more successful procedures. It is probable that when a surgical operation is found necessary, scraping with Volkmann's spoon will be most satisfactory: the lupus tissue is softer than the healthy structures, and is more readily broken down by the curetting. After it is judged that all the diseased tissue is removed, the area operated upon should be cauterized with an 8 per cent. solution of chloride of zinc or with the galvano-cautery; the wound should then be dressed in an antiseptic manner. No matter how thoroughly curetting may be done at each sitting, it will usually have to be repeated several times before a cure is effected.

The galvano-cautery or Paquelin cautery may be used to destroy the lupus growth: after the tissue has been thoroughly burned away, the wound should be dressed with a moist antiseptic dressing till the slough has separated, and then dusted with iodoform and a dry dressing applied.

When very small nodules only are present, electrolysis may be used for their destruction: the needle is to be thrust into the lupus nodule and the skin immediately surrounding it until it is judged that sufficient destruction has been produced. After two or three weeks, if the lupus process still seems active, the operation must be repeated. The tediousness of its use forms the principal objection to electrolysis.

Whatever method may be employed, the treatment must be actively followed, and the operations repeated again and again as long as any of the lupus tissue remains.

Scrofuloderma.

As to which diseases shall be grouped under the term "scrofuloderma" there is great difference of opinion among authors. Three different forms of skin trouble occur with considerable frequency in those who are affected with the tuberculous diathesis; these diseases will here be considered as the scrofulodermata proper.

The most frequent form of scrofuloderma is the ulcerous lesion which is often found over tubercular lymphatic ganglia, especially in the neck. When such an enlarged ganglion begins to soften and break down, the skin over it becomes thinned and of a violaceous hue. Finally, the pus and necrotic remnants of the ganglia break through the skin, and an ulcer results. Such ulcers are round or oval, their edges purplish and frequently undermined, their floors covered with pale, unhealthy granulations. A thin more or less purulent fluid is constantly secreted, which dries into thin, light-colored crusts. The progress of these ulcers toward recovery is very slow, and when healing does occur thick, ridged scars result.

Duhring describes a scrofuloderm which consists of one or more large flat pustules seated upon an inflamed base. A crust, which is thin and brown, forms slowly; underneath is an ulcer which has the "peculiar scrofulous character:" the scars are flat and superficial. The same author describes an eruption of small pustules which occurs on the face and extremities in scrofulous subjects, and leaves variola-like scars.

Another eruption which occurs usually in the scrofulous is the lichen scrofulosorum. The disease consists of numerous pinhead-sized papules of a red or yellowish color, situated usually on the trunk, sometimes on the limbs, and not accompanied by itching or other subjective symptoms. The papules often have a grouped arrangement. Each papule is crowned by a few thin scales. This affection is very rare in this country.

Etiology.—The scrofulodermata occur most often in children. That form

which is found with tuberculous lymph-ganglia is due to the presence of the tubercle bacillus.

Lichen scrofulosorum is an inflammation which commences about a hair-follicle or sebaceous gland, but whether this inflammation is of microbic origin is not yet determined.

Diagnosis.—Scrofulous ulcers are to be distinguished from those of syphilis by the history, the concomitant symptoms, and the differences in appearance of the ulcers themselves. Lichen scrofulosorum differs from the other papular rashes in that it occurs in subjects presenting evidences of scrofula, and further that it is not accompanied by itching.

Treatment.—The therapeutic efforts must be directed especially toward bringing the general health up to the highest point. The best of food and out-door life and sufficient exercise will be indicated. Cod-liver oil, iron, and some form of iodine are the drugs most to be recommended. The local treatment of the diseased glands and the consequent ulcers of the skin belong more to the realm of surgery than to dermatology, and the reader is referred to works on this branch of medicine for full details of the various operative procedures. When the ganglia have not yet broken down an ointment of iodoform, rubbed in several times a day, is said sometimes to cause their resolution. This ointment may be made thus:

℞. Iodoformi . . . . . ʒj.
Vaselini . . . . . ℥j.—M.

In lichen scrofulosorum the remedy most in favor is cod-liver oil, given in full doses and also rubbed into the affected skin.

Syphiloderma.

Under the term syphiloderma are included all those manifestations of syphilis which occur upon the cutaneous surface. In children syphilis is almost exclusively a congenital disease. In those exceedingly rare cases where it is acquired it runs the same course and presents the same lesions as the acquired disease in adult life. In congenital syphilis, however, the skin manifestations present certain peculiarities which place the syphilodermata of childhood, as it were, in a special class.

A fœtus affected with syphilis may die *in utero*, and thus occasion an abortion; the pregnancy may progress to term and the child be born with the signs of the disease upon its body; or it may be born apparently healthy, and the skin lesions of syphilis develop only after several weeks. At times infants will be seen presenting evidences of hereditary syphilis in whom no actual eruption may be found upon the skin, but in whom the nutrition of the skin is evidently affected, as it is thin and dry, wrinkled, and parchment-like.

The syphilodermata are accompanied by the general manifestations of the disease, such as inflammations of the nose and larynx, giving rise to "snuffles" and hoarseness; periostitis and epiphysitis of the bones; loss of the hair and eyelashes; iritis, etc.

Congenital syphilis of the skin presents itself as erythematous, papular, vesicular, pustular, bullous, and tubercular eruptions; but it must be remembered that these various elementary lesions may coexist in the same subject or be evolved from one another, just as happens in the acquired forms of the disease. Upon the bodies of infants the *erythematous syphiloderm* may present an appearance and grouping similar to the erythematous syphilide as it

occurs in acquired syphilis: this, however, is not the most common appearance of this form of eruption. The erythematous rash usually begins about the buttocks and perineum, or at times about the neck, as reddish macules, which soon coalesce to form sheets of yellowish-red, shining, often slightly moist skin, which resembles an intertrigo. The eruption differs from intertrigo in that it is not confined to those parts kept warm and damp, as by the diaper, but extends both above and below, being found especially along the back of the thighs and legs, and even on the soles. In regions where warmth and moisture are not present the rash is usually accompanied by a slight branny desquamation. While the eruption is upon the body the palms and soles may be found red and scaling.

The *papular syphiloderm* is the next most common rash of congenital syphilis. The papules are generally discreet, sometimes grouped, flat, more rarely acuminate, and may exist alone or be combined with erythematous eruptions; the papules occasionally scale slightly, are of the brownish-red tint of syphilis, and when of an irregular angular outline may somewhat resemble the lesions of lichen planus; when they occur around the mouth or anus or in other regions where they are exposed to irritation, they may become transformed into mucous patches exactly like those which are found with acquired syphilis. Around parts which are much in motion the presence of the papules causes cracks and fissures, which result in scars, such as are commonly seen in the angles of the mouth and nose in syphilitic children.

The *vesicular lesion*, as the primary form of congenital syphilis, is rarely seen; vesicles are more commonly found developing after some other lesion, as upon papules.

The *pustular syphiloderm* occurring early indicates a severe affection; it may be present on any part of the body, but is usually most abundant on the face, buttocks, and thighs; about the mouth crusts are apt to form, covering superficial ulcers; pustules sometimes form around the borders of the nails. Secondary suppuration may supervene upon any syphilitic rash, and is to be distinguished from the real pustular syphilide. Barlow has described a syphilitic eruption which occurs as small cutaneous abscesses, resembling boils, but having no cores.

The *bullous syphiloderm* occurs quite frequently in the first two weeks of life, and indicates a severe phase of the disease. The bullæ nearly always affect the palms and soles; they may occur on other portions of the limbs and about the lower part of the face, but often spare the trunk entirely. The bullous lesions develop upon dusky-red areas as small vesicles or pustules, which rapidly grow to the size of a pigeon's egg or larger; they may be tense or flaccid, round or irregular in outline, and are usually filled with a cloudy, purulent fluid which sometimes is bloody. When the bullæ rupture a dark brownish-red, somewhat thickened base remains covered with the remnants of the roof of the bulla; at times greenish crusts form, covering an unhealthy ulcerating surface. Death frequently follows this form of syphilis, though by prompt and efficient treatment life may be saved.

The *tubercular syphilide* is not frequent in hereditary syphilis, and then it occurs late, so that it will rarely be found in children. When seen, this eruption is similar to that found in the adult, and most frequently occurs on the face and anterior surface of the legs.

The gumma is a lesion not uncommon in hereditary syphilis, though it is usually a late lesion. Gummata when present exhibit the ordinary signs of these lesions as seen in acquired syphilis, which are so well known as not to

require special description here. They may occur upon any part of the body, singly or in groups.

Etiology.—Syphilis occurring in children is usually the result of a previously existing syphilis in one or both parents. The disease may be transmitted by either mother or father. If the mother be syphilitic, abortion is more likely to occur than where the disease is transmitted by the father, since not only is the ovum directly syphilized by her, but the nutrition of the embryo is interfered with by the impaired state of the parent's blood. In regard to the question whether a woman who is free from syphilis at the time of her impregnation by a healthy man, but who contracts the disease at a later period of her pregnancy, can then infect her fœtus, there is great difference of opinion. The experiments of Pellizzari go to show that the vehicles of syphilitic virus are cells, or, at all events, formed albuminous bodies. Under ordinary circumstances only the serum of the blood of the mother passes into the circulation of the fœtus, and we should not expect it to become thus infected; but the writer can see no reason why, if some syphilitic inflammation occur in the placenta, the cellular elements bearing the poison might not pass directly into the fœtus.

It seems to be a fact founded on careful observation that mothers of syphilitic children who are themselves apparently healthy do not acquire the disease from nursing and handling the children, while healthy nurses often do: the facts disclosed by modern research concerning the immunity against infections conferred by the so-called antitoxins of the blood-serum of an animal suffering from the disease, when introduced into the blood of another animal, are of interest in this connection.

Diagnosis.—In making the diagnosis of hereditary syphilis a thorough knowledge of the personal history of both parents is of importance; but in the absence of such knowledge the diagnosis can usually be made by attention to the characteristics of the lesions as they present themselves upon the child's body.

The erythematous syphilide is most apt to be mistaken for an intertrigo on account of its situation, but it differs in the fact that it extends beyond the regions which alone would be involved in intertrigo.

The bullous syphilide may be mistaken for acute pemphigus neonatorum, but it can be distinguished by the facts that the bullæ are in the palms of the hands and upon the lower part of the face, while the trunk is left almost free, and that they are often seated on an infiltrated brownish-red base and contain cloudy serum or pus.

Prognosis.—In a general way it may be said that the greater the length of time between the acquiring of syphilis by the parent and the procreation of the child, the better will be its chances for life. The date of appearance of the rash on the infant and its severity will largely determine the prognosis; thus a child born with a bullous eruption will very likely die in a few days, while one developing a roseola in the second month will probably survive.

Treatment.—The treatment of hereditary syphilis is conducted in accordance with those principles which govern the therapy of acquired syphilis in the adult, with such modifications as are demanded by the age of the patient. For a very long time efforts have been made to introduce medicaments into the nursing infant along with the mother's milk: for this purpose mercury has been administered to the mother even when she gave no evidence of the disease. Only the most minute quantity of mercury has ever been discovered in the milk under such circumstances, so that, save as an accessory form of treatment, it is not to be recommended.

The best method of administering mercury to infants is unquestionably by a modified form of inunction. The preparation best adapted for this purpose is an ointment of equal parts of unguentum hydrargyri and vaseline. A piece of this as large as a hazelnut is rubbed into the abdomen of the child night and morning, and the entire abdomen is closely covered with a white flannel binder. Once a day the abdomen should be washed with warm water and white castile soap before new ointment is applied. The same binder should be used continuously, as it becomes gradually charged with the ointment, so that it produces a constant inunction with every motion of the infant. In case the skin becomes irritated, the application may be temporarily suspended, or inunctions given in the usual way may be substituted till the binder can again be applied.

If there be lesions upon the belly which will prevent the use of the method just described, mercury should be administered by the mouth. Calomel and mercury with chalk are the preparations most used; from one-eighth to one-half grain of either preparation, made into a powder with sugar of milk, should be placed upon the infant's tongue just before it is to be nursed, three times a day. Tannate of mercury, in doses of one-twentieth to one-eighth of a grain, is prompt in its action, and is said not to be likely to cause intestinal disturbance. The bichloride of mercury has many enthusiastic advocates. One of the best methods of giving it is in the form of Van Swieten's liquid, the formula of which is—

℞. Hydg. bichloridi . . . . . 1 part.
Spts. rectificat. . . . . 100 parts.
Aquæ . . . . . 900 parts.—M.
Five to ten drops of this should be given three times a day.

The administration of mercury by hypodermatic injection has been in use for many years: it gives prompt results, and the intestinal tract is not irritated as when the remedies are given *per os*. As the method partakes somewhat of the nature of a surgical operation, the parents nearly always raise objections to its employment; its use will therefore usually be confined to those cases in which the symptoms are very urgent. In the hypodermatic administration of mercury the bichloride is the most satisfactory salt, and should be given in doses of one one-hundredth to one twentieth of a grain.

The use of bichloride-of-mercury baths is of value, principally as an aid to other methods of giving the drug. Seven to thirty grains, with an equal quantity of ammonium chloride, are dissolved in some hot water, which is added to a bath consisting of eight gallons of warm water; the child should remain in the bath from five to ten minutes, and should then be warmly wrapped up; the bath may be repeated every second or third day. If no signs of weakness or loss of appetite result and the patient improves, the use of the baths may be continued.

The use of iodide of potassium is restricted to the later manifestations of hereditary syphilis, such as gummata, bony lesions, cerebral affections, eye and ear troubles, etc. When thought necessary, it may be given by itself in doses of one to five grains three times a day, freely diluted, or it may be prescribed with more benefit in combination with mercury:

℞. Hydg. bichloridi . . . . . gr. j.
Potass. iodidi . . . . . ʒss.
Syr. aurantii cort. . . . . .
Aquæ . . . . . āā fʒij.—M.
Sig. Five to ten drops, with plenty of water, three times a day.

Aside from the specific treatment of syphilis itself as detailed above, the general health of the child should be cared for. It should have mother's milk if possible: when this cannot be given, a young syphilitic wet-nurse should be obtained, for a healthy woman by suckling a syphilitic child exposes herself to great risks. In the absence of either one of these means of supplying nourishment, cow's milk, properly diluted to render it as nearly as possible like human milk, should be given. It will often be of the utmost importance to endeavor to assist the general nutrition by the administration of cod-liver oil, malt, and hypophosphites. If the child be anæmic, some preparation of iron will be beneficial; it may be given in the form of the saccharated carbonate, or, if mercury be administered by the mouth, the lactate of iron may be combined with it:

℞. Hydrarg. chlor. mit. . . . . gr. iss.
Ferri lactatis . . . . . gr. v.
Sacchari albi . . . . . q. s.—M.
Ft. pulv. No. x.
Sig. One to four a day.

In whatever form mercury is given, its effect must be closely watched; upon the appearance of anæmia or intestinal trouble or general weakness it should be temporarily suspended. Even if the child be doing well it is always best to stop the drug, during the whole course of treatment, at the end of every month; after a week or so it may be again resumed. The treatment should be continued for some time after all signs of syphilis have disappeared, and the patient should then be constantly under the notice of the physician, so that at the first sign of any relapse treatment may be resumed.

In the presence of ulcerative lesions local applications should be made; after the ulcer is thoroughly cleansed with some antiseptic solution, it should be dusted with the following powder:

℞. Zinci oxidi . . . . . ʒiij.
Iodoformi . . . . . ʒss.
Hydg. chlor. mit. . . . . ʒss.—M.

The ulcer, if discharging, should then be dressed with bichloride gauze, but if fairly dry unguentum vaselini plumbicum may be spread on cloth and placed over it. Condylomata and mucous patches should be frequently washed with a 2 per cent. carbolic-acid solution, thoroughly dried, and then dusted with the same powder. In some cases the use of iodoform excites a dermatitis of the surrounding skin; it should then be left out of the formula.

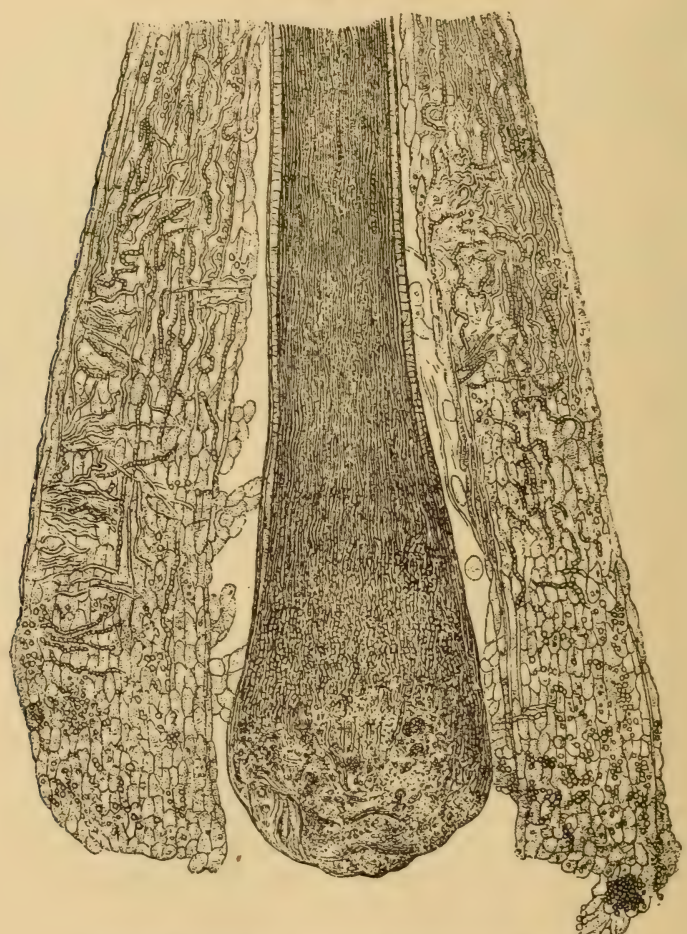
Affections of the mucous membranes, such as "snuffles," should be treated by douches of a 2 per cent. boric-acid solution, and any localized lesions touched with nitrate of silver in strengths appropriate to the condition.

PARASITIC AFFECTIONS.

Tinea Favosa.

Favus is a vegetable parasitic disease affecting the skin and its appendages. It is most common on the hairy scalp, though it occurs on the general surface, and at times attacks the nails. On the scalp the favus fungus grows in the hair-follicle, in which it gives rise to an inflammation which often spreads to the adjacent tissues. If seen in the beginning, erythematous, scaly, itching patches will be noticed; after a time the scutula develop, and these are the characteristic clinical signs of the disease. At its full development the scutulum is a sulphur-colored, cup-like mass, slightly

Fig. 3.



Achorion Schœnleinii in hair-shaft and follicle (after Kaposi).

elevated above the surface of the scalp, surrounding a hair and dipping into the follicle; these cups are about an eighth of an inch in diameter. In the the course of time the scutula touch each other and become fused into a grayish crust, which, firmly adhering to the base of the hairs, may cover a large portion of the scalp. The hairs in the affected area become dry and



TINEA FAVOSA

lustreless, and, as their nutrition is destroyed by the fungus, gradually fall, thus leaving irregular more or less bald areas. A peculiar odor is to be detected in those suffering from favus, which has been likened to the odor of a mouse's nest. When favus attacks the general surface, it usually commences as vesicles surrounded with inflammatory areolæ; after a time the characteristic scutula develop upon the skin. When the nails are involved a yellow spot, in reality a scutulum, may occasionally be seen at one point: more often, however, the nails become rough, dry, brittle, pitted, and gradually crumble away. When the disease has existed upon the scalp for any length of time, permanent atrophy and loss of hair result. The affection generally begins in childhood, and, untreated, may persist for years or throughout life. The subjective symptoms are limited to a slight itching.

Under the microscope the scutula are seen to be formed almost entirely of fungus.

Etiology.—All those conditions which depress the general nutrition, such as bad food, foul air, and filthy surroundings, predispose to favus. The disease exists in many of the lower animals—cats, mice, etc.—and it is likely that it is often conveyed from these to man. The cause of tinea favosa is the achorion Schœnleinii (Fig. 3), which invades the horny layers of the epidermis, the root-sheaths of the hair especially, and often the hair itself. Recently, Quincke, Unna, and others have separated the achorion Schœnleinii into several varieties: certain trifling clinical differences in favus may be accounted for by the presence of one or the other of these forms.

FIG. 4.



Achorion Schœnleinii (after Kaposi).

Microscopically, the fungus of favus is distinguished by the short and jointed appearance of the mycelia, by the rarity of the smooth-bordered mycelia, and by the great number of conidia (Fig. 4). Unna states also that the mycelia of favus grow at right angles to the strata of the horny layer of the epidermis, while in other fungi the direction is more nearly parallel.

Diagnosis.—Only in the beginning, or after the scutula have united into a large mass will the diagnosis be difficult: here it is necessary to distinguish favus from eczema, ringworm, psoriasis, seborrhœa, and lupus erythematosus. The simplest way of arriving at a definite diagnosis is by an appeal to the microscope.

Prognosis.—The prognosis must be given with care. When upon the

scalp, if the disease has been of long standing, there will be permanent loss of hair. When apparently cured it is prone to relapse.

Treatment.—Whatever method of treatment may be pursued, it must be supplemented by patience and perseverance. In recent cases the disease may yield promptly, but in those of longer duration treatment must be continued for months. If any depraved state of the general health be noted, it must receive attention. The treatment of the disease itself is purely local. First, the crust must be removed; this is best done by cutting the hair short and then saturating the scalp for a night or two with sweet oil, when the crusts may be readily scraped away with a spatula. Perhaps the most important part of treatment is epilation, as by this procedure not only are masses of the fungus actually removed with the diseased hair, but the follicle is thus opened up and more readily permits the entrance of medicaments. Epilation, if practised over a small area at a time, is not a severe operation, especially as the hairs are loosened by the disease. As soon as the hairs have been removed the following solution should be applied:

℞. Hydg. bichloridi . . . . . gr. ij–iv.
Alcoholis . . . . . f℥j.—M.

This solution should be mopped on the affected area once a day, and especially applied to those parts that have just been epilated.

An ointment of chrysarobin and ammoniated mercury has been useful in the hands of the writer:

℞. Chrysarobini . . . . . ʒss.
Hydrarg. ammoniati . . . . . gr. xx.
Vaselini . . . . . ℥j.—M.
Sig. Rub in well at night.

Chrysarobin is prone to excite in many persons an erysipelatous inflammation of the scalp, and its use therefore demands caution: it is best to begin with a weak ointment and gradually to increase the strength.

A great number of parasiticides have been recommended by authors, among them sulphur, tar, carbolic acid, salicylic acid, sulphurous acid, oleate of copper, various preparations of mercury, etc. It will often be found necessary to vary the use of these drugs, as they seem to lose their effect after a time.

While the diseased area is being treated with these remedies the whole scalp should be washed daily with a saturated watery solution of boric acid, the intent of this procedure being to prevent the inoculation of the fungus upon new areas. Every two or three days it will be necessary to remove the old ointment by shampooing with a liquid soap made thus:

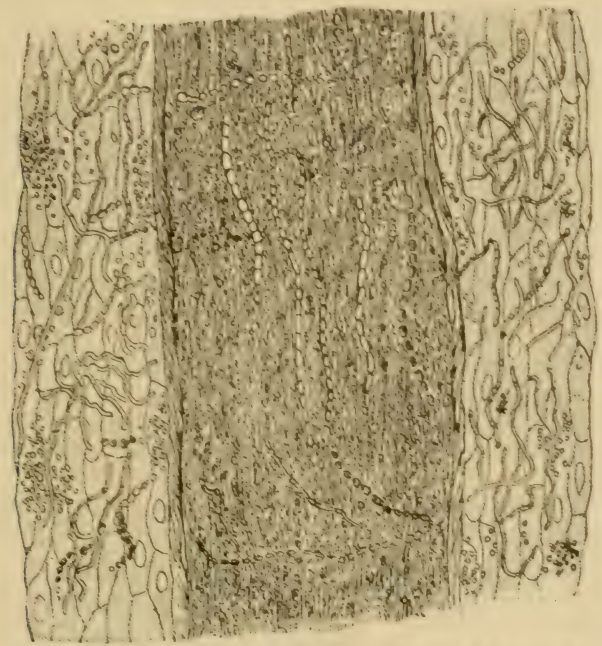
℞. Saponis olivæ præp., ... ℥iij.
Alcoholis . . . . . f℥iij.—M.
Sig. A tablespoonful for each shampoo.

After the treatment has been continued till all signs of the disease have disappeared, the patient should be kept under observation for several months, and at the first sign of relapse treatment should again be actively instituted.

Tinea Trichophytina.

The trichophyton fungus grows in the skin, hair, or nails; in each situation it gives rise to such peculiar clinical phenomena as to merit a special name. As seen on the skin the disease is known as *tinea circinata*, or ringworm of the body. The most common sites of the eruption are the exposed surfaces—the face, the neck, the hands. The first evidence of the disease is usually a small, faint red, slightly raised, scaling spot; this soon begins to spread peripherally, while at the same time healing occurs in the centre; thus there is produced a ring of small scaling papules enclosing a healthy area of skin. The border goes on enlarging till it reaches the size of a dollar, when the disease may spontaneously disappear, or remain stationary for an indefinite time. Often there are several such rings close together; as they enlarge their borders touch, and, disappearing where contact occurs, leave gyrate figures. Occasionally several rings may be found, one within the other. If the inflammation excited be severe, we may see the border composed

Fig. 5.



Trichophyton tonsurans in hair-shaft and follicle (after Kaposi).

of vesicles or pustules instead of papules. Occasionally the centre fails to clear up as the border grows, and thus plaques of reddened, somewhat thickened, scaling skin occur. Rarely the disease involves the nails, when they become rough, lustreless, and brittle.

Tinea tonsurans, or ringworm of the scalp, is almost never found in the adult, being essentially a disease of childhood. It occurs as one or more circular scaly patches, in which the stumps of broken hairs may be seen, not lying in one way, as is natural to the hair of the scalp, but pointing in all directions. The color of the affected scalp varies, in dark complexions being a dirty gray, while in blonds it is a faint red. When the hair becomes diseased, it loses its lustre and is very brittle, so that it readily breaks off. The loss of hair in

the patches is occasionally complete, and the scalp is left smooth and shining, so that the disease is indistinguishable from an alopecia areata. In a rare form of the disease, known as *tinea tonsurans disseminata*, there occur scattered over the scalp small clumps of diseased hairs. Sometimes small pustules may be seen around some of the hairs in an affected area; this resembles what occurs in a more severe form in kerion, which is an acute folliculitis, giving rise to a circumscribed, doughy swelling, studded over which may be seen the widely-gaping diseased follicles. When pressure is made upon such a swelling, a thick muco-purulent material exudes from the follicles, which have usually lost their hairs.

Ringworm of the scalp is not accompanied by subjective symptoms. Untreated it may continue indefinitely.

Etiology.—The cause of ringworm is the trichophyton fungus.[1] It is an odd fact that it attacks the scalp almost always only in children, while the general surface may be affected at any age. The fungus exists in the lower animals, and may be transferred from them to man; it grows only in the epidermic structures, and is not found in living tissues.

Diagnosis.—Tinea circinata must be distinguished clinically from syphilis, eczema, psoriasis, and seborrhœa. In syphilis the concomitant symptoms will generally suffice for differentiation; the border of the circinate syphilide is more sharply defined and of a darker red color than the border of ringworm; the erythematous syphilide is widely diffused and scaling is absent. In eczema the itching forms a marked feature, and the disease, as a rule, does not present the sharply-defined border of tinea circinata, while exudation and crusting are more marked; furthermore, when tinea occurs in solid plaques, so as to resemble eczema, it is often present simultaneously on the scalp. The lesions of the circinate form of psoriasis present a heavier scaling, and the disease may often be found occupying its characteristic sites on the knees and elbows. In seborrhœa the scales are thick and greasy, and on their removal patulous sebaceous ducts may be seen.

Tinea tonsurans may be confounded with alopecia areata and eczema, psoriasis, and seborrhœa affecting the scalp. In eczema the patches are not sharply limited, crusting and itching are present, and the hairs are only matted together, not broken, as in tinea. In psoriasis the scales are thick and abundant; the hairs are not affected; and the disease may be found elsewhere, occupying its favorite sites. Seborrhœa usually affects the whole scalp; the scales are greasy; and, though the hair is thin, no broken or twisted stumps are seen. Ordinarily tinea presents a very different appearance from alopecia areata with its smooth shining patches of perfectly bare scalp; in those cases of tinea mentioned above, which very closely resemble alopecia areata, often some affected hairs may be discovered at the border of the patches, and a microscopical examination may reveal the true nature of the disease.

In every case of tinea the surest way of avoiding mistakes is by a microscopical examination. Scales should be removed or hairs drawn and placed in a few drops of liquor potassæ upon a slide and covered with a cover-glass; after a few hours the scales or hairs will be rendered transparent enough to permit the fungus to be seen. The trichophyton fungus occurs as smooth-bordered branching mycelia, and as conidia, single or in chains (Fig. 5); in the hair both forms may be found in the inner root-sheath and in the substance of the hair itself.

Prognosis.—Ringworm of the body is readily curable. On the scalp it may last indefinitely unless the treatment be kept up with untiring patience and vigor.

[1] Recently Sabouraud and others have described four varieties of the trichophyton fungus.

Treatment.—The treatment of tinea circinata is purely local; it is usually readily cured. Often a few applications of tincture of iodine will suffice, or one of the following ointments may be used:

℞. Acidi salicylici . . . . . gr. xxx.
Sulphuris præcip. . . . . ʒj.
Vaselini . . . . . ʒj.—M.
Sig. Rub into affected area once or twice daily.

℞. Hydrarg. ammoniati . . . . . gr. xx.
Lanolini . . . . . ʒj.
Olei olivæ . . . . . fʒij.—M.
Sig. Apply twice a day.

℞. Cupri oleatis . . . . . ʒss–j.
Vaselini . . . . . ʒj.—M.
Sig. Apply twice a day.

In the treatment of tinea tonsurans the entire armamentarium of the physician will sometimes be required to bring about a cure. As a preliminary step the hair should be cut short and all scales removed. Epilation, though not absolutely necessary, is no doubt of assistance, and should be practised in all inveterate cases; many advise removing the hairs from the area immediately surrounding the patch of tinea, thus hindering its spread. During the whole course of treatment the head should be washed daily with soap and water, and then sponged with a saturated solution of boric acid. In young children, the disease in the beginning will often yield to a simple ointment like the following:

℞. Sulph. præcip. . . . . ʒj.
Ung. aq. rosæ . . . . . ʒij.
Lanolini . . . . . ʒvj.—M.
Sig. Apply twice a day.

Coster's paint may be applied to the patch with a stiff brush every four or five days, the formula of this is:

℞. Iodine . . . . . ʒij.
Colorless oil of wood-tar . . . . . ʒv.—M.

In an epidemic recently treated, the application of a 1 per cent. aqueous solution of rosanilin hydrochlorate, rubbed in well once a day, served to check promptly the disease in its early development.

Of the mercurial preparations, the oleate and white precipitate are the most efficacious. They may be prescribed in the form of ointments varying from 2 to 5 per cent.

In the experience of the writer the most valuable drug in the treatment of chronic cases is chrysarobin. It may be used in the form of an ointment slightly modified from that recommended by Hutchinson:

℞. Chrysarobini . . . . . ʒss–j.
Hydrarg. ammoniati . . . . . gr. xx.
Liq. carbonis detergentis . . . . . ♏xx.
Lanolini . . . . . ʒj.
Olei olivæ . . . . . fʒj.—M.
Sig. Rub in at night.

Chrysarobin must always be used with caution on account of its tendency to excite severe inflammation.

Crocker thinks highly of the use of croton oil in cases of limited extent in children over six years old; it may be used in a liniment with olive oil, 1 : 10, rubbed into the patch until inflammation is excited; or it may be pricked into the diseased follicle with a needle; the suppuration which the croton oil excites destroys the fungus.

Of late much has been said in favor of the employment of electric cataphoresis in the treatment of tinea tonsurans. The positive sponge electrode is saturated with a 1 per cent. solution of corrosive sublimate and applied to the patch, while the negative electrode is placed upon some other part of the body.

When the fungus has invaded only a few follicles or remains in a limited number in spite of treatment, the electric needle may be introduced and the follicle destroyed.

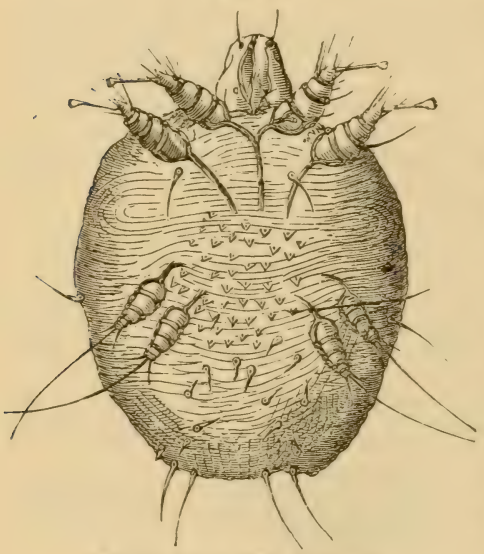
In kerion the hairs should be pulled and some soothing antiseptic ointment applied.

In any case of tinea tonsurans treatment is to be actively continued as long as any hair-stumps can be detected.

Scabies.

This disease is not so common in this country as on the Continent. The lesions seen in scabies are due to the ravages of the itch mite (acarus scabiei). It is only the female which attacks the skin, the male merely remaining upon the surface. The female burrows under the epithelium for the purpose of laying her eggs. She lives about two months, and lays in this time about fifty eggs, which hatch in two weeks. The itch-mite selects those parts of the skin in which to make her burrow where the epithelium is not very dense, as between the fingers, flexures of the joints, axillæ, about the genitals, etc.

Fig. 6.



Female Acarus (after Anderson).

The lesions found in scabies are those directly due to the presence of the mite and secondary ones due to scratching. The burrow is the most characteristic lesion. This consists of a small, fine, black, zigzag line, from one-eighth to one-half an inch long, lying just beneath the upper layers of the epidermis. It is often difficult to find the burrows, as scratching and bathing destroy them. Sometimes the acarus may be seen lying at one end of the burrow as a small white speck.

The presence of the itch-mite excites various grades of inflammation: papules, vesicles, and pustules will be found intermingled on those parts of the body where the skin is thin and where warmth and moisture exist. In

infants in arms the face is often involved, as it is kept warm by pressure against the mother when the child nurses; the feet and buttocks may present the lesions of scabies, as they are protected by the warm clothing. Itching is severe, and we usually find various lesions as the result of scratching—scratch-marks, crusts, furuncles, and pigmentations. None of the lesions of scabies show any tendency toward grouping, but are scattered irregularly over the surface.

In severe cases nearly the whole body may be involved, while in very mild ones only a few scattered papules or vesicles may exist. If not treated, the disease may persist for years.

Etiology.—Though markedly contagious, the disease does not seem to be communicated by ordinary contact, but only by prolonged exposure, such as wearing infected garments or sleeping in infected beds. No age, sex, or social condition is exempt, but filth and infrequent bathing give the acarus a better chance by leaving its burrow undisturbed.

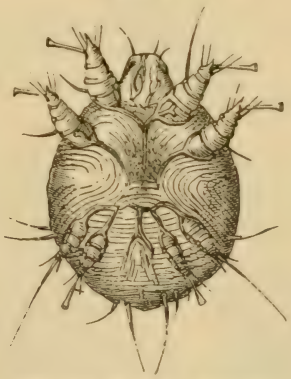
Diagnosis.—Scabies might be mistaken for an eczema, but eczema does

FIG. 7.



Larva (after Anderson).

FIG. 8.



Male Acarus (after Anderson).

not present such multiformity of lesions, is not apt to be so widely disseminated, and the individual elements are aggregated or grouped. The finding of the burrow, and more especially of the acarus itself, is proof positive of scabies (Figs. 6, 7, 8).

Prognosis.—The prognosis of scabies is always favorable.

Treatment.—The disease is readily cured if the treatment be properly carried out. Before any local application is given the patient should receive a hot bath, with thorough rubbing, using green soap. Probably the most generally successful remedy in the treatment of scabies is sulphur. The following ointment should be well rubbed in over all the affected parts of the body morning and evening for three days:

℞. Sulphuris præcip. . . . . ʒiij–vj.
Vaselini . . . . . ℥vj.
Ol. rosæ . . . . . q. s.—M.

The same under-clothing and sheets should be used until the treatment is completed; then the patient takes a hot bath with soap, puts on fresh underclothes, and sleeps between clean sheets, all that he has previously used being boiled; his outer garments should be ironed with a very hot iron.

Many other remedies have been recommended, and a few of the most useful formulæ are added:

℞. Styracis liquidi . . . . . f℥j.
Adipis . . . . . ℥j.—M.
Sig. Rub in twice a day.

℞. Sulphuris præcip. . . . . ʒj.
Balsami Peruv. . . . . ʒss.
Vaselini . . . . . ℥j.—M.
Sig. Rub in twice a day.

Kaposi advises the use of naphthol.

It is of the utmost importance, no matter what method of treatment may be used, to prevent reinfection by attention to the rules in regard to clothing and bedding above laid down. If, when specific treatment is completed, the skin remains inflamed and irritable, some soothing ointment should be used; the following answers very well:

℞. Zinci oxidi . . . . . ʒj.
Ung. aq. rosæ . . . . . ʒij.
Lanolini . . . . . ʒvj.
Sig. Apply as often as necessary.

Pediculosis.

In the children of the poor the head-louse is very common, and occasionally the pubic-louse may be found on the hairs of the eyebrow or on the lashes. On the head the louse (Fig. 9) is most apt to confine itself to the occipital region; here the irritation it causes, together with scratching, soon sets up a dermatitis, which may range from a few scattered pustules to a condition in which the whole region is covered by crusts and exudes a thick, sticky liquid, which mats the hair and by its decomposition gives rise to a disagreeable odor: this purulent matter may be conveyed to other parts of the body upon the fingers, and thus set up a pustular eruption. The lymph-ganglia of the neck, which communicate with the lymphatic channels of the scalp, are apt to become enlarged, tender, and in poorly-nourished children may suppurate. If the hair be long, so that it hangs upon the neck, a similar dermatitis may be caused in that region.

Fig. 9.



Male Pediculus Capitis (after Kuchenmeister).

Fig. 10.



Nits of Pediculus Capitis (after Kaposi).

Whenever we find a pustular eczema confined to the occipital region of a child, we should at once look for pediculi. If these are present only in small numbers, it is often easier to discover the eggs or nits than the louse. Usually one or two nits will be attached to a single hair, though sometimes many are found upon one shaft; they appear as small white specks firmly attached to the side of a hair. They may be mistaken for crusts, but a hair passes through the centre of a crust, and a crust may be easily brushed away, while a nit is firmly

glued to the shaft. In the rare cases where the pubic louse has infested the eyebrows or lashes of a child, the most noticeable signs of its presence are the punctate hæmorrhages in the surrounding skin, caused by the bite of the insect. In these regions the pediculi and their knits may be found upon the hairs close to the skin.

Etiology.—Pediculosis is contracted by contact with a lousy person or some object containing pediculi, such as hats, caps, and other articles of clothing.

Treatment.—In children the hair should be cut short and the crusts softened with olive oil and removed. The head should then be thoroughly anointed with petroleum, the parents being warned not to allow the child to approach a lamp or fire while the coal-oil is on the hair. The petroleum, having remained on all night, should be washed off the following morning with soap and water. Two such applications, made on successive nights, will kill the pediculi, but the nits are more difficult to destroy. To remove them, in cases where the hair cannot be cut off, it should be taken up in small bunches and carefully sponged with vinegar; this softens the glue which attaches the nits to the hair-shafts, so that they may be readily removed with a fine-toothed comb.

The treatment as above detailed, if carefully carried out, will be found entirely satisfactory. If for any reason petroleum cannot be used, the following ointment may be applied for several days:

℞. Hydrarg. ammoniati . . . . . gr. xx.
Vaselini . . . . . ℥j.—M.

Whatever method of treatment may be used, a dermatitis will still remain, which should be treated by soothing ointments.

PART XII.

DISEASES OF THE EAR.

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Philadelphia.

The organ of hearing is, in its normal function, one of the most important of the body, especially in the child, since it is the seat of the sense which is second to the sight only, if at all, as the link between the individual and his fellows, and through the help of which a very large part of his education is acquired and his value as a worker made available. Loss of hearing reacts sadly upon most adults in cutting them off from easy intercourse, and is very apt to engender a suspicious and discontented frame of mind; while in the child it is still more serious, since it bars, to a greater or less degree, so many channels of learning, sympathy, and practical usefulness before they have even begun to convey their wealth to the forming mind.

The diseases of the ear are of great importance, also, because of their frequency and seriousness—facts which are all too little understood or accepted—for they endanger life, as well as function, much oftener than do the more noticed lesions of the eye, which are probably little more numerous. They are far more insidious and readily overlooked in children than in adults, since complaint is rarely made of any subjective symptom except pain; and only slowly will parents generally appreciate that the alleged "slowness" or "stupidity" of children, and their habit of "asking over again," are due to a real physical infirmity. Add to this the weighty fact that in childhood are quietly laid the foundations for most disqualifying and steadily progressive forms of deafness, which are little amenable to later treatment, and the importance becomes manifest of their recognition at the earlier period, when they can be successfully combated.

Embryologically, the organ of hearing arises in three distinct portions, the first being the otic vesicle, which forms as a pouch from the epiblastic surface, develops to form the labyrinth, and becomes distinctly nerve-tissue in part and intimately connected, by the auditory nerve, with the brain; the second is the mucous cavity, extending out and back from the pharynx in the line of the closed second branchial cleft to form the Eustachian tube and tympanic cavity, including the so-called mastoid antrum and the communicating cells; while the third portion is a cutaneous projection and pouch growing outward and in, respectively, to form the auricle and the external auditory meatus. Mesoblastic tissues remain as barriers between these parts, yet serve to link them together—the tympanum having the drumhead with the malleus separating it from the external ear, and the bony labyrinth-capsule with the membranes of the fenestra constituting the division between it and the internal ear.

Physiologically and pathologically, this distinction is maintained; the

internal ear remaining as the sound-receiving apparatus, in contrast to the conducting apparatus external to it: and disease shows that the labyrinth inclines to share in brain disorders; the tympanum remains part of the upper air-passages, involved in most of the lesions of that tract; while the external ear suffers little except from the disorders of the cutaneous surface. Clinical work, likewise, maintains the divisions thus defined, and our methods of study fall largely into the three forms of topical, pneumatic, and acoustic measures according as the external, middle, or internal ear is aimed at. Treatment of the aural disorders is principally on the same lines; and, in spite of the incompleteness of the demarcation in some instances, this forms the most natural and advantageous division of our subject.

In the study and treatment of the ear in children some care is generally requisite as to the holding of the patient. If small, he is usually best held in the lap of an adult, as the mother, with head resting upon her breast and the ear to be examined turned toward the physician. One arm passes around the child's waist from behind and holds the hands, while the other is ready to steady the head or meet any other requirement. Some throwing back and twisting of the head may be expected; but the physician's hand in drawing and holding the auricle outward, backward, and down or up, as the configuration of the parts may demand, can take points of counter-pressure for his hand upon the child's head and do much to steady it. In mopping and other manipulations the movements of the child should be followed as closely as possible, especially if the ear is painful, for much roughness and restraint may be thus avoided. The active struggles and screaming of a child cease most acceptably in many instances as the applicator actually enters the ear, and perfect quiet is maintained until it is withdrawn, as though the child, in anticipation of something awful, were reserving its powers to do justice to the occasion. With older children quiet can often be obtained by allowing them to *stand* or sit free, while the examination is directed first to the unaffected ear, the nose, and the throat, and they are plied with questions, jesting as well as serious. Moderate stillness yielded spontaneously is generally better than that which can be enforced by the efforts of three or four strong adults, and considerable patience in winning confidence and obedience will usually prove good policy; but if restraint has to be enforced, it should be as overwhelming as possible, so as to demonstrate the futility of resistance and the real gentleness of the treatment, for it is generally fright or wilfulness, rather than pain, that is the disturbing element. Facility in the measures of examination and treatment, especially without instrumental aids, counts for a great deal, since every speculum, tongue-depressor, or other instrument may be an object of terror as well as a probable source of discomfort. The unaided view into a canal may be restricted and incomplete, yet if the light spot can be seen and no redness is visible along the handle of the malleus, tympanic inflammation may be excluded: and flakes of epidermis, etc. along the walls may then be let alone, which would be pushed up before a speculum and require removal before any view could be obtained.

Affections of the External Ear.

The external ear, although tangible and prominent, is far less important for our consideration than the middle, and furnishes hardly 25 per cent. of aural work; and the labyrinth suffers so rarely that less than 10 per cent. of ear diseases affect it, leaving the mucous membrane of the tympanum to bear the responsibility of quite two-thirds of all aural disorders. Yet access to the

deeper structures is partly through the auditory canal, and the disorders and study of this portion may best be first considered.

The auricle, as a skin-covered projection of fibro-cartilage, is open to ready inspection and palpation for its study, and its position exposes it to trauma as well as to various cutaneous affections. Its *congenital malformations* of distortion, reduplication, or defect are of interest rather as curiosities than as pathological conditions, and, except for appearance' sake, rarely concern the aural surgeon. Supernumerary auricles or auricular appendages may be removed if conspicuous; the persistence of the branchial cleft, as the so-called "aural fistula," may call for a tiny plastic operation to close it; huge auricles may be brought to more reasonable dimensions by the excision of a wedge-shaped segment, or very prominent auricles may be fastened more closely in by excising a crescentic flap behind them. These are mere matters of surgical common sense. Minuteness of the auricle or absence, congenital or traumatic, may tempt the surgeon to plastic efforts; but it must be remembered that without cartilaginous framework any semblance of an auricle is quite hopeless, and that transplanting of cartilage, except from the adjacent meatus, has always proven a failure. Upon the hearing, these conditions are practically without influence, and any rash experimentation is unjustifiable.

The habit of piercing the ears for ear-rings is responsible for some of the lesions of the auricle, aside from the tearing of the lobules from traction upon them; for the services of an itinerant vender of ear-rings are sometimes followed by a surprising group of cases of abscess of the lobule, apparently affecting in a neighborhood every little girl who had not previously been subjected to the rather barbarous custom. Although usually limited and without diffused infection, these abscesses deserve some surgical care, for their healing may be slow and disfiguring. The infiltration may be of less passing nature, and there may result a fibroid or so-called keloid tumor, which tends to grow rather persistently and to recur after removal. These are rather uncommon, except in the negro. The malignant tumors are too rare, even in adult life, to demand notice. Dermoid cysts, probably congenital, may occur in the sulcus behind the auricle, and cyst-like perichondritic effusions or hæmatomata may fill the concavities of its anterior aspect as the result of trauma.

The *inflammatory lesions* of the auricle are almost always of an eczematous character. *Herpes* is rarely met and hardly distinguished with certainty, except by the occurrence of severe pain for hours or days before the visible lesions. True *erysipelas* is very rare, though not infrequently simulated by a severe eczema. *Specific lesions* may take almost any form, though generally pustular or rupial.

Eczematous Inflammations.—These are usually secondary to some irritant, such as an excoriating purulent discharge from the tympanum; and the main measure of treatment is protection from the cause, which should be removed if possible. The eczema is generally marked in the furrow back of the auricle, where fissuring may be deep and inveterate, and cicatrization may bind the auricle tightly down upon the mastoid; but fissures of the lobule and intertragus notch may be deep and disfiguring. The dyscrasia, conveniently though vaguely termed "strumous," is apt to underlie and strongly influence the condition; and similar lesions of eyelids, nares, and lip are apt to be present, with swelling or suppuration of the adjacent glands. For its cure eczema often demands long, varied, and laborious treatment. Internally such tonics as cod-liver oil, hypophosphites, and iodide of iron are called for, with close attention to the hygienic surroundings. The diet must be regulated, the perversions of appetite, which have often been encouraged by giving cakes

and candy to still the fretful child, must be corrected, tea, coffee, and other inappropriate food forbidden, and simple but generous nourishment given. Locally, cleansing to the verge of meddling is called for as often as the lesions become crusted, since healing is generally tardy or absent beneath the inspissated discharge. Alkaline solutions or peroxide of hydrogen will soften the crusts and permit their removal with little violence, and while all rude handling is detrimental, it is generally less so than permitting the pathological tissue to remain bathed in pus and protected from medication beneath its incrustation. Any of the many lauded measures may prove promptly successful or largely futile, but a routine treatment, with a bland calomel ointment (gr.xx–xl, ad vaseline ℥j), has usually served me excellently. In the very moist forms free painting with silver nitrate may make a better beginning, and drying powders, such as boric acid, may be used on the eczema, as well as in the suppurating tympanum from which the irritation has often proceeded. The ichthyol ointment has decided value in reducing the swollen lymph-glands, and may be well used upon the infiltrated aural surfaces, especially after visible lesions are about gone, yet there remains a rigidity, which is often a useful diagnostic sign.

Furuncle.—Circumscribed inflammation of the external canal is less common in children than in adults, who are more inclined to scratch the irritated and itching surfaces caused by eczema. Yet it is met at times, as is a similar lesion of the auricle. Its painfulness raises its importance beyond anything due to its influence upon the function, although it may close the canal by swelling in a way to muffle hearing and to conceal and possibly seriously obstruct a deeper suppuration. Diagnosis may remain uncertain, and call for treatment as though a tympanic lesion were certainly present. Cleansing with hydrogen peroxide, rubbing in of a salve of the yellow oxide of mercury, and firm pressure by a conical cotton pledget, will generally secure prompt resolution; but sometimes this cannot be borne, and must be substituted by the rather agreeable and pain-relieving hot douche. The poultice or moist warmth in any form is to be deprecated, and the warmth or actual heat furnished by a salt-bag or hot-water bottle must be relieved of any macerating effect by the thorough drying of the ear after douching. No single measure is as valuable in aural treatment as this hot douche, serving as it does to clean away secretion, to reduce swelling by relieving stasis, and to soothe the pain; and it is as applicable to the acute tympanic inflammation as it is to the external suppuration of the canal, and is especially appropriate in the mixed cases. Any sort of syringe, gently used, will serve, the bulb and nozzle of soft rubber being often best; but a medicine-dropper or a teapot will do nearly as well, and the temperature should be as high as the patient can be induced to bear. Careful use of the cotton-carrier, under illumination by the forehead mirror, should follow, if possible, in order to remove the moisture, to press out secretion from any open furuncle, to disclose and possibly dislodge any cerumen mass or unsuspected foreign body (recent or long present) which may be hidden beyond the swelling, and, as a probe, to demonstrate the most swollen and tender point as a preliminary to incision. It can also seek for uncovered bone beneath a discharging opening; for it must not be forgotten that the furuncle may lead to caries of the wall of the canal; and, still more important, that burrowing of pus from deeper localities, in antrum or attic, may appear externally as furuncle-like lesions. The knife may shorten treatment and is indicated to release pus, but, without prejudice to the result, it can often be dispensed with, to the patient's great mental relief. When used, the smaller and sharper the blade the better, a cataract knife-needle being admirably suited to this and similar incisions, which may be almost painless when pointing is well marked. A

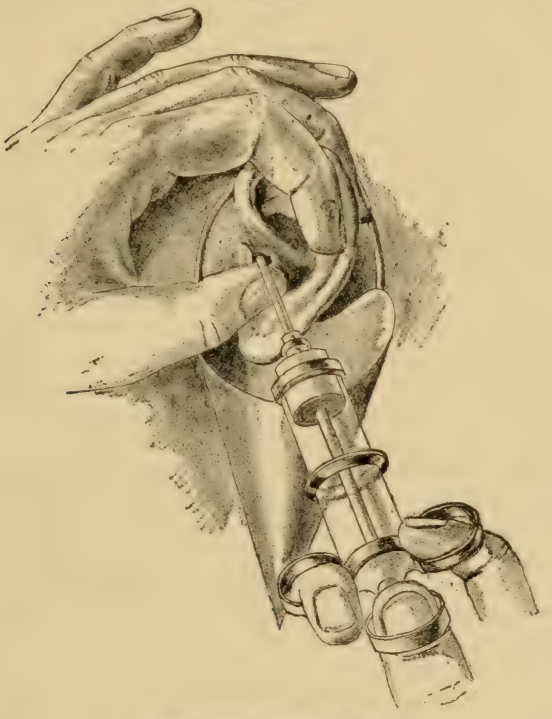
series of furuncles is to be expected, and prognosis and treatment given accordingly. Whether to be ascribed to dyscrasia and demanding tonics, or regarded as a matter of microbic auto-inoculation to be combated by rigid antisepsis, both local and general measures are indicated to forestall or control this tendency.

Cerumen Impaction.—This is also much less common in the child than in later life, associated as it so often is with a chronic tympanic catarrh. It is almost invariably a sign of lessened, not increased, secretion of wax, with change in its consistency, so that it tends to mass in dark scales or lumps instead of passing constantly out in tiny, light, unnoticed flakes. Those who suffer are often victims of misplaced efforts at cleanliness, for Nature is given no chance to displace the material as it forms, but meddlesome attempts to hasten the process push back and pack inward the emerging masses. The epithelium seems to grow most rapidly at the centre of the drumhead, and to tend to push outward from this point to the margins and then along the meatus walls; so an outward march of the lining skin and all that rests upon it is generally discernible, the slow progress of which is aided, as the exit is approached, by the movements of the jaw. Many have probably felt at times a little tickling in the ear, and found that a wax-flake had been ejected by the spring of hairs upon which it had been pressed. The movements of the auricle, also, whether accidental or by its own muscles, serve to dislodge any clinging masses. Formed, as the cerumen is, only in the outer two-thirds of the canal, it can only by interference be pressed into the deeper parts, although the epidermal débris which serves to increase the collection can arise in the neighborhood of the tympanic membrane. So long as the mass does not absolutely occlude the canal, sound-waves may pass through an invisible crevice and the hearing remain perfect; but the hygroscopic mass can easily swell, if only through atmospheric moisture, and thus give rise to sudden deafness. If there has been displacement of the mass, as in the movements of the head upon the pillow, pressure upon the drumhead or other sensitive point may also be suddenly caused, with most varied and possibly severe, reflex attacks of vertigo, coughing, or symptoms of more remote and inexplicable character. The unsuspected presence of these masses should never be forgotten, and both ears looked into, not only in aural patients, but in all nasal and many other obscure cases.

Treatment.—This consists in syringing away the collection with hot water. Previous instillations of oil or glycerin are to be deprecated as rarely useful and not always harmless; and medicinal additions to the syringing fluid do little, if anything, to increase its efficiency. Plain water is about as good a solvent of cerumen as can be found, and its value increases with its temperature. At the same time, the dizziness or faintness which syringing oftener than other aural manipulations is apt to cause is less probable or severe if the fluid be warm. The water must be thrown with well-controlled and well-directed force; so the canal must be straightened by traction, illuminated with the forehead mirror, and the stream directed along one wall, especially up and back, in the attempt to insinuate it beside the mass. The syringe is to be emptied with gently increasing force, and after the first ounce or so, the fluid ought to be stained with dissolved cerumen, the softened lumps should follow, and soon the residual mass, softened and reduced in size, appears in the exit, and may be hastened out, if it clings there, by a touch of the probe. If fair employment of the syringe has not been thus successful, with good illumination and a steady hand the mass may be touched with a probe, such as the cotton-carrier, and gently loosened, when the syringing will probably succeed. When the epidermal element is large and the solubility correspondingly small, considerable instru-

mentation may be needful; but it takes a skilful hand to employ forceps or curette safely or effectively. A small sharp spoon is a most useful instrument, for with it a channel can be excavated in the centre or side of the mass, portions displaced so as to be easily grasped and withdrawn by the forceps, or the whole engaged and adroitly extracted. Yet it is decidedly dangerous, and the

Fig. 1.



The Aural Syringe in Use.

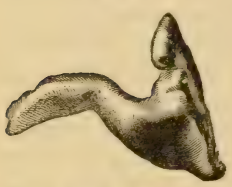
blunt ear-spoons more so than the sharp ones, since the operator is apt to presume upon the supposed innocuous character of the former. First and last, and often between-times, the syringing is to be relied upon as the really appropriate measure; and, well used, it will rarely need much help in securing complete removal of impacted cerumen at the first sitting. On clearing the canal some congestion of the walls and drumhead is usually seen, with excoriation, perhaps, if the pressure of the mass has been ill borne or the manipulation rough in removal. The canal should be gently dried with absorbent cotton on the cotton-carrier, any excoriated surfaces lightly dusted with boric acid, and the exit filled with a flake of cotton in order to exclude the dust and too rapid movement of the air. A repeated visit should be called for, to make sure of prompt restoration to normal; while any tympanic catarrh should be appropriately treated at the first as well as later visits.

Foreign Bodies in the auditory canal owe their importance almost solely to the utter misapprehension with which they are regarded and the maltreatment to which the ear is often subjected on their account. They are rare, and generally of no importance if let alone; but the panic with which they are frequently regarded by patient and parent is too often fostered by the almost breathless haste with which the physician undertakes heroically to remove them.

Placed in the canal with little pressure, kept in place often only by the force of gravity, the foreign body may be ready to fall out spontaneously as soon as the ear is directed downward so as to permit it. Shaking or jarring of the head may greatly aid this, and rotary rubbing in front of the tragus will often serve to coax an intruder out. The jaw condyle presses upon the canal and narrows it, so the mouth should hang open, and the meatus should be drawn outward and back to straighten it. The syringe, with warm water, is the proper instrument for the removal of the great majority of foreign bodies, not excepting seeds and such bodies as will swell if long soaked. Swelling of the canal-walls through irritation or injury in rash attempts at removal may preclude prompt success by this means: if so, the hot irrigation will be of value to reduce it. The canal may be dried with absorbent cotton and the body dehydrated with alcohol or glycerin if maceration or germination is feared, a drying powder, such as boric acid, dusted in, and, unless urgent symptoms should arise, further intervention delayed until a more favorable occasion. It is important, however, to preface any attempt with an explanation of the intention to do only a limited amount of intervention because of the danger of overdoing; for this will come with better grace and find readier acceptance *before* a non-success. The temperature and general condition must be closely watched if expectancy is attempted and brain-symptoms looked for; but if great violence has been done, delay is both safe and advisable. Nearly half of the foreign bodies noted as found in our clinics have been present longer or shorter times without the knowledge of patient or friends.

Accurate diagnosis is of course a prerequisite to any intervention, and this will, as usual, be much aided by inspection of the fellow-ear. Thus we can learn the probable size and form of the canal, the pre-existence of eczema or other irritation which may have led to the introduction of the foreign body, and other valuable points. Not very infrequently a foreign body is really present in the fellow-ear, either because one has been placed in each ear, or because, in the panic over the case, its true location has been forgotten. The cases are far too numerous where harsh or destructive efforts at extraction have been blindly made in the wrong ear or in one from which the intruder had already fallen out. The presence and the nature of a mass to be removed must, therefore, be decided, although in some instances blood or swelling in a maltreated ear may preclude certainty of diagnosis. The hearing should be tested by speaking or whispering questions or commands into each ear, better with the other one closed with a finger-tip; since retention of good hearing is of good omen as to the incompleteness of impaction and the uninjured condition of the tympanum—points of great prognostic importance. The syringe should be used gently at first, and so directed as to seek a passage past the body if visible and localized, the upper back wall of the canal being generally the best along which to throw the stream. Much ingenuity has been wasted in trying to float up with mercury a foreign body too heavy to be readily lifted by the stream of water, when the mere inclining the ear downward while syringing would have far more effectually enlisted the aid of gravity. This position is awkward and need not be attempted at first, until syringing has been vainly tried in the ordinary fashion. Here, as in all syringing, work under good illumination with the forehead mirror is strongly advisable; for syringing may wholly fail when blindly used, though perfectly

FIG. 2.



METAL CAST OF THE AUDITORY CANAL OF A CHILD, showing the marked flexure usually found at junction of bony and cartilaginous portions, and the inclination of the drumhead. Although quite movable in the canal, the cast was withdrawn only by violent traction.

competent if intelligently employed, and the well-straightened canal is as necessary for success as in inspection. When well seen, yet immovable by a strong and well-directed stream of water, a gentle touch of the probe may do good service, if the patient is quiet and tractable; for much may thus be learned as to the impaction, and perhaps the body rotated into better position or disengaged.

If space beside the body can be seen and vigorous syringing has failed to move it, a delicate wire-loop may be passed beyond it and serve as an efficient yet gentle tractor. But all use of instruments is dangerous, even in hands well accustomed to precisely these manœuvres, and should rarely be attempted except under ether, and then with great caution. Almost no form of forceps is to be commended, since they are apt to injure the walls and push the body deeper in the attempt to grasp it; and slipping, as they so often will, even when fairly and firmly placed, they are almost sure to drive the intruder deeper. Yet some wholly unsuitable pair of forceps, thrust into the canal of an unanæsthetized and struggling child, on the mere suspicion of a foreign body, without aid of illumination, is rather generally the first resort of the practitioner who has little experience in aural work, and scarcely enough knowledge of the anatomy not to share the "lay" fear that the body, unless removed at any cost, may work its own way into the brain. The risk of brain lesion is indeed great when the ear is subjected to such an attack, for there may be no foreign body there to be encountered, and the ossicles or any other normal structures may fall victims to the heroic resolve not to retire empty-handed. If present, the body will probably be driven through the drum-head into the tympanum, with more or less destruction of the ossicles; and the numerous fatal results on record give ghastly but incomplete evidence of the seriousness of the situation. If such an impaction in the tympanum has occurred, and the air-douches through the Eustachian tube and syringing through the meatus both fail, little place remains for expectancy or gentle measures. Only in cases with no fever or disquieting symptoms can the brush of glue be allowed to attach itself to the mass, or delicate skilful traction by instruments be tried in the effort to dislodge the body. It is actually safer and simpler to dissect the auricle and cartilaginous canal forward, and work with free view in the short, broad bony canal, chiselling away the upper back wall if greater space is needed, than to do unknown and more serious damage to the deeper structures in the effort to work through the natural passage. The fact that this operation has not been more often done since it was proposed argues little for the manual skill of aural and other surgeons, and much against their wisdom and judgment.

Caries of the Wall of the Auditory Canal may occur apparently idiopathically, and cause much enlargement through loss of tissue. The granulation tissue formed is sometimes redundant, and the healing process may cause fibrous stenosis or division of the canal by a membranous septum across it. Bony outgrowths may also arise, congenital, perhaps, in origin, yet increasing later, and may narrow and close the canal.

Congenital Atresia, or defect of the meatus, may be met, with or without malformation of the auricle. Operation may, with difficulty, secure patulency in cases where the closure is by soft tissues; but the formation or freeing of a canal closed by bone is a serious and often unsuccessful measure. Good bone-conduction must be present as evidence of a useful labyrinth; and the hearing by way of the Eustachian tubes may be as good as the case admits of; so these passages are to be kept in as open a condition as possible. The proper location of the auditory canal is to be determined by the mastoid process,

for the auricle may be widely displaced; and as absence of the tympanum may render nugatory all efforts, drilling or such procedures can be attempted only with great caution.

Affections of the Middle Ear.

Inflammation of the Middle Ear, arising, as it generally does, from a nasal origin by way of the Eustachian tube, may involve any or all portions of the tract, from the pharyngeal mouth of the tube to the remotest cells of the mastoid. It is readily distinguished into acute and chronic, with a few intermediate forms, and the types of catarrhal and suppurative, which are distinct and strongly contrasting in the chronic inflammations, are with less certainty distinguishable in the acute. Localized subdivisions can be made, *a fortiori*, as the brunt of the attack falls on the tube, drumhead, or mastoid, or the disease tends to cling there, as salpingitis, myringitis, or mastoid periostitis, etc.; yet such nomenclature can be strictly applied in few cases, and rarely with profit, especially if taken to mean that adjacent parts are free from implication. The gravity of all the severer middle-ear inflammations lies in the facts of the proximity of very important structures like the labyrinth, the meninges, and the great blood-vessels, and that to a large extent the lining mucous membrane is practically the periosteum, and readily causes the dependent bone to share its inflammation or its destruction. What would elsewhere in the air-passages be a mere superficial mucous ulcer may here lay bare the bone to carious or necrotic process. The intricacy of the tract also hampers the escape of the secretions and degenerated products; and retention of these maintains and increases the disease at the focus, often gives rise to most excruciating suffering, and may lead to penetration of septic material in most dangerous directions.

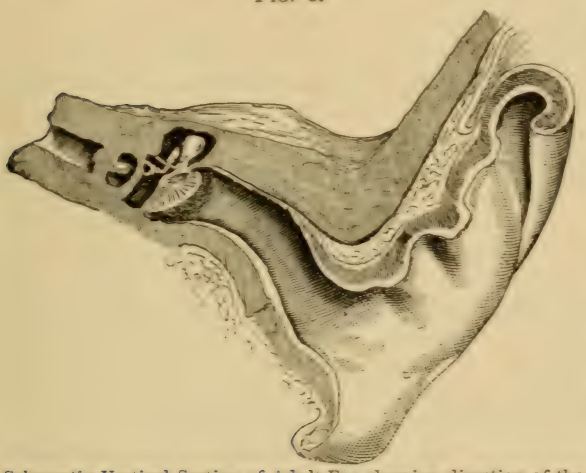
Acute Simple Inflammation of the Middle Ear.—This usually originates in a coryza by an extension of the process up the Eustachian tube; for as this entire tract is essentially a part of the upper-air passages, its involvement is as natural as that of the pharynx. Bathing, especially in the surf, with penetration of the water into the naso-pharynx and tubes, is responsible for many cases, some of which are ascribed to the action of the cold water in the external canal; and the improper use of the nasal douche or syringe is fairly blamed for a further series of cases, sometimes disastrous. Intranasal surgery has not infrequently such a sequence, and all too often the aural inflammation takes on the suppurative character. All of the exanthemata, including typhoid, are very apt to give rise to it, and its symptoms are likely to be ascribed to the general condition or be masked by it; so routine investigation of the ears is called for in such cases. The prime symptom is usually earache; and the prevalent error of regarding this as an entity instead of a symptom, and combating it by narcotics instilled into the ear, instead of striking at the underlying inflammation, is responsible for many unhappy results. Neuralgias of the ear are rare, and while points of reflex irritation may be suspected and sought in teeth, tonsils, and other neighboring structures, it is only after careful investigation, proving the uninflamed condition of the aural tract, that a painful condition should be set down as otalgia. Usually in children some fever is present, there is tenderness elicited by pressure on the tragus or traction on the auricle, and inspection will show a congested and perhaps distended condition of the drumhead.

It is important here to correct misapprehensions as to the drum-membrane in childhood, which have been fostered by some of the authorities.

The tympanic membrane and the annulus in which it is set are upon the sur-

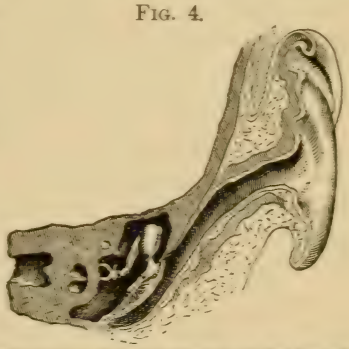
face of the skull in infancy, open to view when the soft structures have been removed, and revealing the nearly horizontal inclination of the drumhead: hence the impressions that the tympanic membrane is more superficial and more horizontal in infancy. Neither is true; for the canal is about thirty millimetres long, as in the adult, with a membranous portion where the tympanic scroll later forms the bony canal; and removal of the bony canal in adults shows that the two drumheads maintain identically the same inclination to each other as in infants. Much as is the growth of the temporal bones and their separation by the occipital, the plane of the tympanic membrane, like its size, is unaltered after birth. An anatomical point which lends color to the error has much practical importance. The direction of the adult canal is upward as it passes inward, while the auricle falls downward and forward, and must be drawn up and back to straighten the cartilaginous portion (Fig. 3). In infancy the auricle is above the tympanum, and the flaccid canal is pressed against the upward-curving surface of the squama, and can be straightened only by drawing it *down* and out (Fig. 4). Long, narrow, and readily collapsing, the infant meatus gives but a poor view of the drumhead, even when correctly straightened; and the distinction between back wall and drum-membrane is unrecognized, unless shown by the normal coloration. In an inflamed ear the practised eye is often puzzled to find landmarks or make a certain diagnosis, and one less expert is apt to make insufficient attempt to discern details—too soon discouraged because the picture is not unmistakable. Yet the triangular light spot on the lower anterior portion of the drumhead ought to be visible in every healthy ear, and from its absence or alteration valuable data can be easily obtained as to the position and surface. The malleus handle ought to be distinguishable, and any congestion will show first and last in the plexus along its posterior margin. Distention of the tympanic membrane generally shows up and back, and the color indicates the character of the collection, being generally greenish if filled with serum or mucus—yellowish, if purulent; while the thinness of the sac usually reveals whether only a bleb or the whole thickness is protruded. Inflation of the tympanum, if successfully accomplished, generally alters the appearances; thus giving evidence of the patulency of the Eustachian tube and a new view of the

Fig. 3.



Schematic Vertical Section of Adult Ear, showing direction of the auditory canal and the length of the bony portion.

Fig. 4.



Schematic Vertical Section of the Ear of an Infant, showing the usual direction and length of the auditory canal.

tympanic condition, with a clear surface line to the contained fluid, perhaps, or bubbles moving in it. The pneumatic speculum may do similar service in clearing obscure details, whether inflation succeeds or fails.

Congestion, serous exudation, and hypersecretion of mucus are the usual stages of the affection; and imperfect drainage by the Eustachian tube constitutes a cause for retention and pressure. In the absence of septic infection and consequent suppuration, there is little danger, except to the hearing, in adults; but with children the barriers are too thin and imperfect to protect the meninges and other important structures from involvement, and most severe brain-symptoms, which are not always merely reflex, may arise in cases where the collection is simply mucus. Stupor, hemiplegia, convulsions, opisthotonos, and other indications of meningeal or cerebral inflammation may occur, with little to direct attention to the ear; and marvellous improvement may be gained, as though by magic, from relief of the pressure, either by freeing the Eustachian tube or by incising the tense drumhead. For diagnosis, as well as treatment, therefore, the nares should be sprayed free of any mucus, the pharynx vault and tube-mouths mopped with the curved cotton-carrier passed above the velum, and the inflation tried with the Politzer bag. If no voluntary aid be given by the child in puffing out the cheeks, saying "Huck," or swallowing, a cry will often be as helpful; and often the short, wide, flaccid tube opens readily without special assistance. A quick, spontaneous movement of the hand to the ear will often tell of the passage of air to the tympanum; and as this may be painful, its first employment should be gentle, with force increased when needed. No harm is likely to result, even should the increased pressure cause rupture of the tympanic membrane, for this can happen only when it is about to occur spontaneously.

Exit of the secretion by its normal drainage-channel may be impossible because of tubal swelling or from the tenacious character of the mucus, and incision of the drumhead may be demanded in order to give relief. This should be a simple and harmless measure, yet its pain is often severe enough to forbid its needless performance. It may cause injury to the stapes or the inner tympanic wall if done with a stab, and has been known to open the head of the jugular; and it may convert a non-suppurating into a septic inflammation if all the requirements of asepsis are not secured and maintained. It must be done, of course, under good illumination, and should generally be preceded by delicate use of the probe in order to let touch assist sight in getting the true relations. The most protruded portion of the membrane should usually be chosen, and the needle-point inserted for a distinct cutting motion, avoiding any contact with the ossicles or inner wall. The oblique position of the drumhead must be clearly borne in mind, and a hand skilled in aural procedures is generally requisite. Inflation of the tympanum should follow, if possible; and hot syringing of the canal will remove the blood and evacuated secretion, allay the pain, and serve to favorably stimulate the inflamed tissues and inaugurate resolution. The canal should then be gently dried and protected by a flake of cotton or wool, and a pad of the same laid on outside in unfavorable weather. The same result can commonly be gained without incision, and, unless the symptoms are urgent, the little operation had better be delayed. The hot syringing can impress the tympanum, controlling the pain and other symptoms, about as fully and favorably with the drumhead intact. Nasal treatment, aided by the shrinking effect of cocaine, can generally free the Eustachian tube and fairly maintain its patulency; and dry heat, as by a hot-water bottle, can increase the comfort and further the cure. The hot douching should be frequently employed, and if drying be done with reasonable care, no undue mace-

ration need be feared. Greatly distended drumheads can thus be brought back to normal condition with perhaps greater safety and promptness than by more radical intervention.

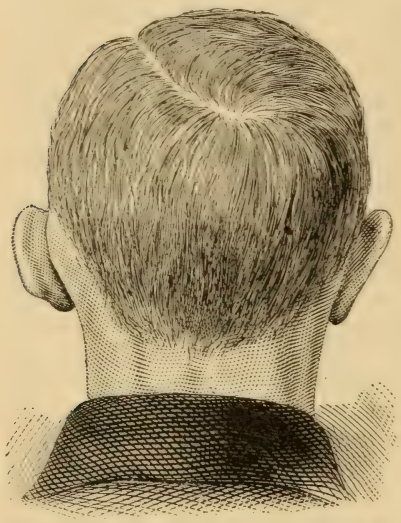
The habit of treating "earache" by instilling sedatives is not to be commended. Any fluid introduced should be warm, and is efficient in proportion to its heat rather than to its ingredients. A tincture, such as laudanum, is apt to be irritating; oils and glycerin are more apt to harm than help; and cocaine, except in strong solution, has less value than atropine or morphine. More than would be a full dose by the mouth had better not be instilled, lest it find penetration and cause poisoning. Poultices are apt to macerate, and are generally inferior, in convenience and directness of application, to hot douching or fomentations. They should be used very hot, if at all, and removed before they have cooled to the body temperature. They are so liable to improper use that their employment is not to be commended. Leeching is advisable only during the rise or acme of the inflammation, and is rarely well borne by children. As it is generally impossible to determine at first whether the acute tympanic inflammation will prove suppurative and serious, the prognosis should be guarded and the treatment include rest in bed, with regulated diet and antifebrile medication—matters easier to regulate in children than in adults. After improvement has begun, protection against renewed or increased cold-taking is still very important, and covering of the ear-region is advisable in inclement weather. Tonics and alteratives may be necessary as well as advisable—cod-liver oil probably serving better than almost any other. Chloride of ammonium and syrup of iodide of iron are each very useful in its place. Quinine, which is often taken to "break up a cold," has been vigorously condemned by some aurists because it stimulates the circulation in the ears as well as elsewhere. Yet stasis is worse than active congestion, and the facts by no means fully support the contention as to its counter-indication.

One form or phase of acute tympanic inflammation deserves a word in passing. The most inflamed and distended portion of the drumhead is sometimes its upper flaccid portion, especially the part above the short process of the malleus. This indicates collection in the upper tympanic cavity, or attic, and the rather isolated pouches of this region, largely independent of the condition elsewhere. Rupture may give exit to a single drop of fluid with relief and prompt resolution; but the perforation may remain as a pinhole opening—the so-called "foramen of Rivinus"—claimed to be a congenital defect of development, although less often seen in children than in adults.

Acute Suppurative Inflammation of the Middle Ear differs little from the catarrhal form in its onset, although apt to be more severe in its febrile and painful symptoms. It is specially characterized by the rupture of the drumhead and more persistent flow of secretion, which generally contains pus and the pyogenic bacteria. The perforation is less often the mere pushing apart of the tissues, although frequently assuming a pouting, nipple-like form, for there is generally some loss of substance; and in the cases due to scarlatina and diphtheria the destruction of the membrane may rapidly be extensive or total. Ulceration of the inner surface of the drumhead is only one indication of the destructive influence of the inflammation or its products; and as the attic and antrum are generally involved, as well as the tympanum proper, the dangers to meninges, blood-vessels, and mastoid are real and great. Paracentesis may be promptly called for, either to make or enlarge an opening, if the symptoms point to retention of secretion; and the temperature should be carefully watched for evidence of extension or exacerbation of inflammation. Tenderness of the mastoid and other neighboring parts is to be frequently sought;

and it, with or without swelling, redness, or œdema, calls for redoubled precautions. The position of the auricle should be critically compared with that of the other side, especially by study from directly behind the head (Fig. 5), for displacement is almost invariably present if there be any surface involvement of the temporal. The size and form of the auditory canal should be noted, so as to detect any bagging, especially of the upper back wall, by retained secretion. The position of the perforation is probably of small importance, unless it be in the flaccid membrane, as an indication of suppuration partly or wholly isolated in the cavities of the attic; and its form depends principally on its size. The opening at the apex of a pouting, nipple-like protrusion has importance, however, since it is in itself an evidence of incomplete relief of pressure, is rather prone to clogging, and serves as a valve to exclude all medicinal applications. It may readily be mistaken for a polyp, and attacked with the snare; and while this, used only to cut, is not very bad as a method of enlarging the pin-hole opening, any traction may be very injurious.

Fig. 5.



Swelling of the Mastoid Region, pushing the auricle out and forward.

Incision should be free, and maintained, if made at all; for it has a tendency to heal quickly, and even close what little exit was present. Dilatation with a conical pledget is generally better, if practicable. The distinctly unfavorable meaning which the pouting perforation has in adults does not obtain in children; although the muco-purulent secretion, which is its usual concomitant, is in youth almost as dangerous as the more destructive pus. It is most often in such cases that the use of dry boric powder has been charged with dangerous sequences, and caution is necessary, although its contra-indication is not proven. A standing rule may be made for all insufflations, that free use of insoluble powder always brings danger of clogging the outflow; and boric acid is but slightly soluble in mucus. Hot douches are more valuable in these than most cases, since the heat can penetrate to the inflamed tissues when drugs cannot, and the effect upon actual or imminent involvement of the mastoid cells may be most valuable and grateful. In other respects the treatment is much the same as that in catarrhal inflammation—the naso-pharyngeal spraying and mopping, Politzer inflation after such cleansing, and the syringing through the canal for the maintenance of the utmost possible cleanliness of the tympanum. A course of several weeks is usual, and early cessation of the discharge is to be looked upon with suspicion, and evidences of retention carefully sought. The hearing may be much impaired, to improve but slowly; and the termination of the discharge may leave the auditory apparatus unduly dry and stiff, with a temporary decline of the hearing in consequence. It is best to prognosticate this, for patients often retain the old idea that it is dangerous to check all such flows, and may be alarmed or discouraged.

Chronic Suppuration of the Middle Ear.—This condition is almost always the result of a neglected acute attack, although debility may invalidate

the very best treatment and cause the maintenance or recurrence of the condition. Its symptoms are often inconspicuous, and neglect is quite frequent, especially under the impression that "it will get well of itself." Histories in such matters are apt to be wholly untrustworthy, and perforations, cicatrices, losses of the bony parts, massive chalk deposits, or collections of exfoliated epithelium or inspissated discharge may be present in one or both ears which are declared to have been always sound. A tuberculous affection is occasionally insidious and painless in its onset, and may be characterized by multiple perforations, which probably represent broken-down tubercles of the drum-membrane. The exanthemata are responsible for a large number of cases, sometimes following doubtful or unrecognized attacks; while more often the illness of the patient masks the ear disease or overshadows it in apparent importance. The spontaneous cure for which many physicians look, as well as the laity, is often obtained, but may prove temporary and incomplete; and treatment is called for in all cases as lessening the danger to hearing and life, mitigating the annoyance to patient and companions due to the discharge, and tending to hasten and complete the cure.

The character of the discharge deserves attention. If fetid, it tells of retention and neglect; if bloody, polypoid growths are probably present; if ichorous, search should be scrupulously made for dead bone; if stringy from mucous admixture, subacute involvement of the antrum and mastoid cells is probable, and a slow, obstinate case may be anticipated. As cleanliness is the prime factor in restraining evil tendencies and securing resolution, the character and source are noteworthy as bearing on the means required to remove secretion. The syringe remains the best cleanser here, and the heat which its fluid can so well convey can have efficacy little short of that in the acute conditions. Frequently, isolated cavities, into which ordinary syringing hardly penetrates, need cleansing, and intratympanic injections are needed. A steady hand can make these in a quiet patient with almost any long, fine canula introduced, under good light, to the precise point requiring it; but where these requisites are lacking, the auditory canal should be filled with fluid—best the peroxide of hydrogen—and pressure exercised by finger-tip or Politzer bag to force it into every opening; and it can often be thus carried down into the pharynx. In some obstinate cases syringing through the Eustachian catheter proves very efficient, though this cannot so often be used in children. Drying should follow cleansing, and all epidermal flakes or similar material removed as perfectly as possible, even to the verge of meddling. It is never safe to form a diagnosis of the precise condition until the whole accessible tract has been studied by the eye, and perhaps with the probe. Polyp masses or other protrusions often show most characteristically when standing out as reddish islands, surrounded by whitish pus; so study before cleansing is important: and many conditions need probing for their comprehension, for which the cotton-carrier, guarded with a tip of cotton of appropriate size, is best adapted. In seeking for bare bone and roughnesses, the fibres catch upon these, and may not only reveal but remove them. The mopping is an excellent means of cleansing, independent of syringing, and should always follow it to remove the remaining fluid. It also affords valuable instruction and practice in aural, and especially intratympanic, manipulation, preparing the physician for the more delicate measures, such as paracentesis. Often a flake of cerumen-like material clings closely to some part of the wall or fundus, and its removal is requisite in order to learn whether or not a sinus or other lesion lurks beneath. These leathery crusts are common near the short process, and frequently indicate an attic inflammation, with a perforation in the flaccid membrane, and all too often caries of ossicles or adja-

cent walls. Backward, too, there may be an opening into the antrum or its communicating cells sometimes with polypoid granulations surrounding it.

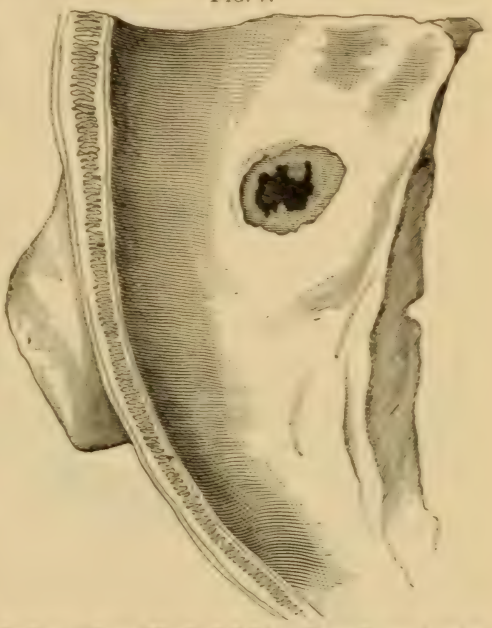
"Polyp of the ear" is no sufficient diagnosis. Although usually a symptom of chronic suppuration of the tympanum, its real cause should be determined as soon and accurately as possible, and its removal regarded as essential to a fair beginning of treatment. In rare cases polyps arise in furuncles, generally after poulticing; but most of them come from the tympanum. When seated upon the canal-wall they generally indicate a carious condition, and call for scrupulous study and care. Their removal is rarely worth considering an operation, since it can often be done without the knowledge of the patient and the probable consequent increase of difficulty. Mere rotation with the probe will often "wring the neck" of a polyp, or it can be bitten off with forceps or snare. The new tissue is generally insensitive, and it is the traction on its base or adjacent parts which is felt more or less painfully. Complete removal is desirable, and chromic-acid or other cauterization of the stump; but the mere drying effect of boric or alum powder often suffices for those not arising from inflamed bone. General anæsthesia may be required for proper exploration and removal, and the arrangements should be made beforehand to carry through at once any requisite operation on the bone. Caries of small extent can often be sufficiently treated by rubbing vigorously with the cotton-carrier, or may be curetted with the small sharp spoon. The ossicles can be excised if considerably involved, since their usefulness is generally gone, and they remain as obstacle to treatment and often to hearing. Yet such intervention is far from sure to give either prompt or lasting relief if confined to cases really demanding it; for it may fairly be claimed in the majority of cases of limited caries of the ossicles that healing can be secured as quickly and surely without excision, and that with it prompt cure can be expected in only some 60 per cent. of the apparently appropriate cases. The operation of Stacke, in which the tympanic attic, and often the antrum, is at the same time laid freely open by removal of all wall intervening between it and the canal, is called for in many of these cases; and the turning forward of the auricle and cartilaginous canal, by incision behind it, greatly favors thoroughness and safety, while not increasing the risk of operation.

Chronic suppurations commonly resist any treatment which parents or nurses can give, and the physician who treats them with no more insight rarely succeeds better. Yet a single thorough cleansing, with insufflation of boric powder, will often cut short a case that has been trifled with for years. Such prompt drying had better be distrusted, for recurrence is probable. Foci of trouble often are unreached, and the exciting causes in nares and tubes generally remain. Hearing may be temporarily lessened by reason of the stiffness of the parts, no longer even duly moist; and perforations in the drum-membrane may be retained by repression of the reparatory inflammation. Yet these charges against the dry treatment are rarely justly condemnatory, and proper maintenance of naso-pharyngeal treatment, with inflation of the tympanum, will generally secure all that any other measures can do, and with real gain in time and safety. Serious secondary conditions, like mastoid empyema or caries may thus be averted; but there is no evidence that they are not rather lessened, and they are not so apt to be masked by the tympanic condition.

Aside from the dangers to hearing, a number of perils surround both the acute and chronic forms of tympanic suppuration. The bony walls are everywhere more or less dependent for their nutrition upon the mucous membrane, and caries of ossicles and other parts can readily take place, with occasionally extensive necrosis. Yet without this, extension of inflammation, even when

not septic, may involve the meninges, the great blood-vessels or the labyrinth; and from any of these serious or fatal cerebral lesions may arise. Brain-abscess depends, in most cases, upon aural suppuration, and subdural abscess and septic thrombosis are still more frequent in children (Fig. 7). Suppuration in the labyrinth gains ready access to the intracranial cavity through the internal auditory canal, and the basilar meningitis resulting is usually fatal. This is noteworthy, for the leptomeningitis due to caries or necrosis of the temporal bone is often salutary, and builds a defence against serious invasion for the more important structures. (See Figs. 8 and 9).

Fig. 7.



Portion of Base of Skull of Child of Three Years, showing carious defect in the roof of left tympanum and the overlying dura. Death resulted from a large brain-abscess communicating with the suppurating tympanum.

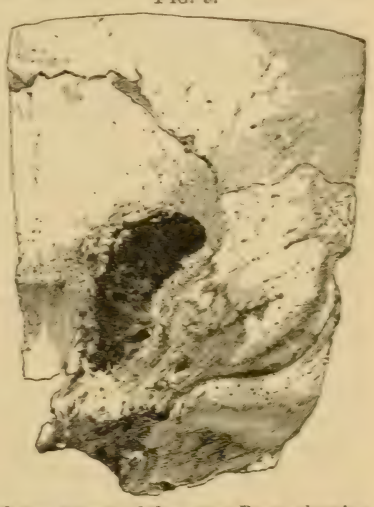
Necrosis may lead to exfoliation of large portions of the temporal bone, including the labyrinth and facial canal; yet the cranial contents may escape unharmed, in spite of loss of much of the meningeal surface of the bone, and the facial nerve may reorganize. Facial paralysis is not rarely met, for the facial canal is frequently incompletely bony, and is always vulnerable as it passes above the oval window. Bell's palsy in children is usually a part

Fig. 8.



Inner Aspect of the Temporal Bone of a Boy of 2½ years, showing caries of roof of attic and antrum. Dural thickening effectually protected the brain at this point, but pus penetrated with fatal result through the internal auditory meatus.

Fig. 9.



Outer Aspect of the same Bone, showing destruction of mastoid cortex and meatus-wall, throwing into one open cavity the canal and tympanic chambers. The oval window is seen, as in life, to be empty: the facial canal above it is open and vacant, and a third opening is into the horizontal semicircular canal.

of an otitis media, although the aural symptoms may be slight and fleeting. When the nerve is actually destroyed, restoration is not likely, and the canal may prove a path for infection. (See Fig. 10).

Burrowing of pus may so easily take place out along the bone, instead of through it, that its presence upon the surface should never be accepted as proof of a bone-lesion, but the region must be carefully searched for sagging of the walls of the canal, especially above, or other indications of subperiosteal burrowing. Up and back, near the drumhead, where but a thin lamella separates the antrum from the meatus, a rounded protrusion, more generally of reddish color, may be found as the result of purulent collection, which has come around or through the bony plate; and the relations of the Shrapnell membrane are such that suppuration in the attic may pass out along the wall, instead of perforating the membrane. Bone-lesion may, therefore, be absent; but as the periosteum is generally detached, superficial caries is almost certain to follow unless prompt relief of the condition is obtained. Incision freely down upon the bone is called for, in order to lay open the tract throughout as soon as it is detected, and stimulating measures, especially the hot syringing, should be vigorously employed. Weak acid solutions, best in 75 per cent. glycerin, have been warmly advocated as capable of decalcifying and aiding to remove any dead portions of bone, while energetically stimulating the growth of healthy granulations.

FIG. 10.



Large Sequestrum, showing much of the outer surface of mastoid. It comprises also much of the facial and semicircular canals, the antrum, and its removal uncovered extensively the dura and lateral sinus, but was followed by recovery, with deafness and facial palsy of this side. The whole temporal bone is sketched in to show the relations of the exfoliated portions.

CHRONIC CATARRHAL INFLAMMATION OF THE MIDDLE EAR may remain as the result of one or more acute attacks, but more frequently is an insidious and progressive disease due to continuous nasal trouble, directly or indirectly acting through the Eustachian tube. These slit-like canals are normally closed, yet open readily in yawning, swallowing, or forced respiration, and serve to ventilate the tympanum and maintain equality of pressure upon the inner and outer surfaces of the drumhead. Nasal catarrh may lead to violent nose-blowing, with undue distention of the tympanum; but much oftener the swelling of the mouth or lumen of the Eustachian tube both guards the ear against this and also precludes the normal transmission of air. The unrenewed air in the drum-cavity is absorbed, the tympanic membrane pressed in by the preponderating external pressure, and swelling or hypersecretion of the lining mucous membrane, or transudation through it, results from the partial vacuum. In still other cases the tube is duly patulous, and nasal obstruction gives rise to suction at every act of swallowing, just as in the "Toynbee experiment" with the nose held closed. Whether thus medially, or through direct extension of inflammation by continuity, the tympanum becomes involved in a low grade of inflam-

mation tending toward sclerosis. So marked is this tendency that some cases may well, from their start, be designated as sclerotic; yet such are rarely recognizable in early childhood, and the hypertrophic form is here the most important. Slight congestion of the whole tract is usually present, as indicated by the distended vessels visible along the malleus handle; infiltrations take place in limited or diffused areas of the drumhead or other parts of the tracts, leading to fibrous or chalky deposits; and, more important still, the ligaments of the ossicles and the less constant reduplications of mucous membrane about them undergo stiffening and contraction. The pull of the tensor tympani upon the malleus handle may thus be exaggerated through the affection of its tendon sheath, increasing the depressed or retracted condition of the drumhead; and the stapes, which is often surrounded by bands of tissue, becomes anchored firmly in its niche or undergoes true ankylosis of its foot-plate in the oval window. The effect of this in hindering the due transmission of aërial sound-waves is evident, for the drum-membrane is stretched too tightly to respond properly to the lower tones, the conduction through the chain of ossicles is hindered, and the cardinal factor—the slight piston-like movement of the stapes—is reduced or prevented. Pain of a neuralgic character is sometimes present, possibly through the sharp pressing inward of the drumheads, and subjective noise or vertigo is apt to be added to the deafness.

Even in childhood chronic tympanic catarrh may be very obstinate and require long and persistent treatment. The naso-pharynx is to be put in the best practicable condition, with reduction of turbinal hypertrophies, shrinkage or destruction of "adenoid vegetations" of the vault of the pharynx, and reduction of the tonsils by astringents, cauterization, or excision. My routine nasal treatment is to spray clean the nares with a detergent alkaline solution, such as Dobell's, mop the pharynx-vault with glycerole of iodine on the bent cotton-carrier, give a protective spray with a 10 per cent. menthol-camphor solution in alboline, and dust lightly with calomel. Inflation of the tympanum can usually be satisfactorily done with the Politzer method, the patient aiding by puffing out the cheeks or saying "Huck" at command. If water is given to aid the swallowing effort, the sip should be small, the inflation made as the larynx is seen to rise, and the physician will be wise to stand out of range of the probable spluttering. If the collapse of the drum-membrane be considerable, its distention may be painful, even by gentle inflation; and it is well to have the fingers thrust into the ears to compress the air in the canals and mitigate the pressure. The air blown in may be advantageously medicated by filling the bag from a bottle containing a little iodine or other stimulant. The pneumatic speculum is of decided value, not only in studying the condition of the drumhead, but also as an excellent means of using massage. Any fulness, pain, or discomfort caused by inflation may be thus promptly relieved, tinnitus and deafness much lessened, and a rational method of relieving the worst features of the trouble readily inaugurated. Its effect can be continued and increased by "tragus-pressure," or pneumatic massage, done with the finger-tip moving in and out while hermetically closing the canal. Valsalva inflation had better not be taught, as it is very liable to be abused, but this other measure is generally as useful and probably wholly harmless.

Affections of the Internal Ear.

Lesions of the internal ear are fortunately rather rare in children. Congenital defects are hard to prove during life, but may be assumed when other malformations are present, with no evidence of disease and where no hearing

has ever been detected. When deafness is total, labyrinthine lesion is almost certain, since disease of the conducting apparatus can hardly abolish the function of the organ.

Acquired Labyrinthine Deafness is usually syphilitic, except in the cases of necrotic destruction or exfoliation as the result of tympanic suppuration; and evidence of the inherited taint should be sought in the eyes and teeth. Even when no sign of interstitial keratitis or other ocular syphilis is found, and the teeth are well formed and spaced, the facies may have a pinched expression, with precocious marking of the naso-labial lines, which is quite characteristic. The loss of hearing is generally sudden, and, although considerable tympanic trouble may be present to confuse the diagnosis, the routine treatment of the middle-ear lesion will prove it to be too slight to be a probable cause of the profound deafness, and alteratives will have distinct influence in improving the hearing. Tuning-fork tests are not very reliable with young patients, even when intelligent enough to understand what we wish to learn, and the objective methods are of uncertain value. It is claimed that through long stethoscopic tubes connecting the ears of patient and observer the tuning-fork on the vertex can be better heard from the less-affected or normal ear if the lesion is labyrinthine, but on the more affected side if tympanic. The contrary is sometimes, if not generally, true. The Galton whistle is of value in testing if any hearing be present, as it can be concealed in the hand and sounded at various pitches in proximity to the ear without attracting any notice unless its sound be heard. Yet the question of total deafness may remain undecided, and the history throw little light upon diagnosis, especially in children who do not talk. Sounds accompanied by concussion, even of the air, are apt to be noticed, and calls and phrases may be comprehended in spite of abolition of hearing; but any words spoken beyond accidental semblances of "ma-ma," etc. may be taken as proof that some hearing is or has been present. Cases of labyrinthine deafness due to extravasation or sudden exudation, and accompanied by the Menière symptoms of vertigo, etc., are very rare in children, and usually unilateral. It is still a question how far acute bilateral otitis interna is mistaken for cerebro-spinal meningitis, the intracranial symptoms of which are merely reflex, and recovery takes place with surprising promptness except for the persistence of total deafness. Such cases do occur, but more often the lesion is doubtless in the floor of the fourth ventricle, with destruction of the auditory tracts; and any labyrinth lesions later found are due to atrophic degeneration.

Whether syphilitic or not, the treatment of these disorders is about the same. A full mercurial impression should be obtained with all possible promptness, and the alterative effect of this drug and iodine well maintained. Mercurial inunction is generally safest and most convenient in children, the ointment being given in drachm or half-drachm pellets, of which one is to be rubbed once or twice daily upon the belly and covered with a flannel band, a new surface being taken each time till the waist is encircled. Pilocarpine has some curative value, but is probably much less safe or certain than mercury.

When hearing is lost in early life, from whatever cause, speech is either not learned or is very apt to be lost, and the child becomes a deaf-mute. Yet some trace of hearing is present in the majority of those in the mute institutions, since the deafness is usually tympanic; and acquired, as it often is, after some language has been learned, this only needs preservation and cultivation. A considerable proportion can be taught to speak intelligibly and read the lips of others with facility. The process is slow and difficult; so it should be begun early and with rigorous exclusion of the easier but far less useful sign-

language. Any remnant of hearing may be of immense aid, and it should be made as good as possible by treatment; and the vocal apparatus should in like manner be put in the best practicable condition, that it may add no needless impediment to the acquisition of useful speech.

Mechanical aids to the hearing may be of value to the mute as well as to other deaf persons, both for hearing the sounds of the words spoken to them and their own voices in speaking. The appliances are of two principal forms—either a trumpet to receive in the expanded mouth a larger number of sound-waves than the ear itself could catch, and transmit them by air-conduction to the auditory apparatus, or else of the "dentaphone" type—an elastic surface to respond to the vibrations and convey them by bone-conduction. Each has its limited value and its applicability to individual cases; and it is claimed that they sometimes greatly facilitate that exercise of the auditory apparatus which can occasionally work a slow but immense improvement in apparently hopeless cases. A similar therapeutic idea has led to use of the phonograph as a means of exercise or massage, especially by the believers in infinitesimals—perhaps "proved" by the fact that the attenuated sounds of telephone and phonograph can work harm to diseased ears. Numerous improved forms have been devised, all promising wonders as soon as, like perpetual-motion machines, a missing cog shall be adjusted.

PART XIII.

DISEASES OF THE EYE.

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In the following pages only those diseases of the eye are recorded which the general practitioner of medicine and surgery is likely to encounter, and which do not demand the use of instruments of precision for their detection and study.

Diseases of the Lids.

Abscess and Furuncle of the Lid.—An abscess of the lid, sometimes called *phlegmon*, appears as a localized red elevation, which may arise in debilitated children without ascertainable cause, and also results from exposure, injury, or diseases of the orbit. The affection may terminate in the formation of a slough or "core," and then receives the name "*furuncle*," and in subjects of poor nutrition may be complicated with gangrene of the surrounding integument.

Treatment.—Pointing should be favored by the application of moist heat with compresses of lint steeped in hot, slightly carbolized solutions. As soon as fluctuation is detected, or even earlier, the abscess should be incised with a knife thrust through it parallel to the muscle-fibres, and the cavity kept clean with a solution of bichloride of mercury or with peroxide of hydrogen. Nourishing food and tonics, as quinine and iron, are indicated.

Hordeolum, or Stye, is a small furuncle on the margin of the lid caused by a circumscribed inflammation of the connective tissue, or of one of the glands of this region.

Ordinarily, the affection, though annoying, is trifling in character; the swelling becomes invested with a yellow cap, indicating suppuration, and the purulent contents are evacuated by spontaneous rupture or by incision. Sometimes, however, the appearances are similar to those of purulent ophthalmia, from which it may be differentiated by observing the indurated portion of the lid, the point of suppuration, and the absence of profuse purulent discharge.

Styes tend to recur or to come in "crops." They are excited by exposure to dust and cold and the strain of uncorrected ametropia, especially hypermetropic astigmatism. The repeated occurrence of styes always indicates some general derangement—dyspepsia, constipation, and, in girls at the age of puberty, menstrual disorders.

Treatment.—An attempt to abort a stye may be made by the repeated application of compresses steeped in hot boric-acid solution, by rubbing the

inflamed area with an ointment of yellow or red oxide of mercury, or by painting the surface with collodion. When suppuration occurs the swelling should be incised by cutting through its base parallel to the lid. Constipation, dyspepsia, and menstrual disorders should be corrected, and in children of suitable age refractive anomalies should be neutralized with appropriate glasses. Sulphide of calcium has some influence in preventing the recurrence of styes.

Exanthematous Eruptions are found upon the eyelids during the various eruptive fevers, and in small-pox a pustule may form, by preference at the commissure, leaving a disfiguring scar, or it may terminate in an ulcer of stubborn character which is denominated *post-variolous ulcer*. Vaccine vesicles on the free border of the lids have been reported by Hirschberg, Berry, and others, after contact with vaccine. The affection receives the name *vaccine blepharitis*.

Blepharitis.—This term describes the various subacute and chronic inflammations of the border of the lids, and the affection usually appears in a *non-ulcerated* and an *ulcerated* form.

The non-ulcerated varieties manifest themselves as a simple hyperæmia of the lid margins, the "red eyes" of common parlance, characterized by swelling, redness, and passive congestion of the superficial blood-vessels; or in an abnormal secretion of the sebaceous glands, characterized by the formation of crusts and scales of hardened sebum (a similar process often affecting the eyebrows at the same time) at the roots of the cilia, and lying upon a slightly inflamed and occasionally abraded surface. Distinct ulcers usually are not present. This form is always bilateral, and is known as *seborrhœa of the lid border*, *blepharitis ciliaris*, or *squamous blepharitis*.

The ulcerated varieties manifest themselves as a *marginal eczema*, which resembles an aggravated form of the simple hyperæmia; or as a *blepharo-adenitis*, characterized by the matting of a tuft of cilia in a crust which covers a distinct ulcer, and which often affects a single lid; or as a *pustular* inflammation, characterized by the development of thick yellow crusts covering deep ulcers that destroy the nutrition of the eyelashes, which are misshapen and readily fall from their follicles. This type, called *blepharitis ulcerosa*,[1] often affects all of the lid margins, and may lead to deformities, owing to the loss of the cilia and the change in the shape of the ciliary border, which becomes thickened, everted, and rounded ("*lippitudo*," or blear-eye).

Etiology.—Blepharitis in many of its forms is distinctly a disease of childhood, and is apt to attack children of blonde complexion and strumous habit. It frequently follows in the wake of the exanthemata, but may arise in other subjects in seemingly perfect condition. Not infrequently, affections of the nares and naso-pharynx are present (various types of rhinitis, catarrh, and adenoid vegetation), which probably act as causative factors. Eczema around the nares and auricle is often present. Ametropia, especially hypermetropia and astigmatism, as originally pointed out by Roosa, probably causes many cases, and is responsible for the continuance of others. Abnormal shortness of the palpebral fissure may originate blepharitis (Fuchs).

Treatment.—This depends upon the type of the disease, but in children of suitable age refractive anomalies should always be corrected. The forms described as hyperæmias will often disappear by this means alone; if not, the lids may be washed frequently with warm water and castile soap, and an eye-

[1] Eczema of the border of the lids, according to its manifestations, was formerly described under several names—blepharitis ciliaris, blepharitis ulcerosa, psorophthalmia, lippitudo ulcerosa, tinea tarsi, sycosis tarsi, ophthalmia tarsi, etc.

douche may be employed, the water of which, at a temperature of about 60° F., is conducted from a can held above the head through a tube to the end of which a small rose is fitted, which distributes the fluid in fine, shower-like jets upon the closed lids. Stimulating salves are not indicated in this variety.

In the seborrhœas the crusts should be removed with an alkaline solution, bicarbonate of sodium (gr. viij–f℥j), or biborate of sodium (gr. iv–f℥j), and then an ointment of milk of sulphur or of resorcin (2 or 3 per cent.) applied to the lid margins. In the eczemas, after removal of all crusts, the yellow oxide of mercury (gr. j–f℥j) is the most useful application. In any type associated with much ulceration all loose cilia should be removed with epilating forceps and the ulcers touched with a solution of nitrate of silver. In place of the salves which have been mentioned, boracic-acid ointment (10 per cent.), zinc ointment, or aristol ointment (2 per cent.) may be used. The puncta and lachrymo-nasal duct should be patulous, and any diseased condition of the nares and naso-pharynx should be corrected. As constitutional remedies, cod-liver oil, lacto-phosphate of lime, iodide of iron, and syrup of hydriodic acid will usually find suitable indications.

Phtheiriasis of the Lids.—The pediculus pubis (crab louse) occasionally infests the eyebrows and eyelashes. The parasites cause much irritation, and the affection may be mistaken for ordinary blepharitis.

Treatment.—The margins of the lids should be rubbed with balsam of Peru, mercurial ointment, or a solution of corrosive sublimate.

Syphilis of the Eyelids.—A hard chancre may develop on any portion of an area included by the lid borders and inner canthus, the tarsal conjunctiva and the cul-de-sacs (De Beck), the inoculation usually taking place by contact with the secretion from a syphilitic mouth. The affection begins as a pimple which develops into a characteristic ulcer with indurated base.

A small papular syphilide has been noted upon the eyelids of infants the subjects of hereditary syphilis a few weeks after birth, and madarosis (falling of the lashes), as well as a form of ulcerated blepharitis, has been ascribed to the same cause.[1]

Tumors and Hypertrophies.—Clear, small cysts, warts, and little masses of granulations may occur on the margin of the eyelid, the last arising from the mouth of a Meibomian duct. In addition to these attention is directed to the following growths:

Nævi (angiomas).—These are congenital growths, either small red spots or cavernous structures analogous to those which occur elsewhere in the body. They should be removed as soon as practicable. If small, excision may be practised: if large, they may be destroyed by galvano-cautery puncture.

Chalazion.—This is a small tumor arising in the tarsus, due to inflammation of a Meibomian gland and its surrounding tissue; hence it is an adenitis or a periadenitis, and not a true cyst. It occurs in children, but is much more common in adolescence. The exact cause is not known, although it is connected with stoppage of the duct of a Meibomian gland, which in its turn may be caused by inflammatory affections of the lid border. Chalazia are apt to occur in the lids of those suffering with hypermetropia and astigmatism.

Treatment.—The lid should be everted and the discolored spot on the tarsal conjunctiva, which marks the position of the chalazion, exposed. This

[1] Those interested in this subject should consult De Beck, *Hard Chancre of the Eyelids and Conjunctiva*, Cincinnati, 1886; and Alexander, *Syphilis und Auge*, Wiesbaden, 1889.

is incised and the contents scraped out with a small curette. Large chalazia should be removed by cutaneous incision, the area of operation being enclosed in a suitable clamp forceps (Snellen or Knapp). Resolvent ointments (yellow oxide of mercury gr. j–5j) have some reputation, but usually their employment is a waste of time.

Sarcoma of any of the types occurs in the eyelids of children, both upper and lower, as a primary growth. At first the growth is movable under the skin and slightly elastic to the touch, but rapidly develops, and may be complicated with ulceration of the overlying tissue. Thorough removal should be practised as soon as the diagnosis is established, but return and metastasis are likely to take place.

Tarsitis.—This is a chronic (very rarely acute) inflammation of the tarsus, often syphilitic in origin, and then consisting of a gummatous infiltration. An idiopathic tarsitis also exists which resembles a chronic blepharitis, from which it must be differentiated by observing the induration of the tarsal portion of the lid. If it be syphilitic, the usual constitutional remedies are indicated; if idiopathic, the treatment of chronic blepharitis is suitable.

Blepharospasm.—This term comprises several varieties of involuntary contraction of the whole of the orbicularis palpebrarum or of a few of the fibres. It is either clonic or tonic in character.

Clonic Blepharospasm.—The most trifling type of the clonic variety consists in the twitching of a few fibres of the muscle, sometimes spoken of as "life in the eyelid," being significant of eye-strain or some loss of tone in the nervous system, and correctible by removing the evident cause. Occasionally, however, it becomes stubborn, and requires, in addition to suitable glasses, the administration of antispasmodic remedies—gelsemium or conium.

That form of nervous disorder which Weir Mitchell has called "*habit chorea*" manifests itself in undue winking of the eyelids and jerky movements of the facial muscles, partaking of the nature of a grimace. It is very common in nervous school-children, and almost always refractive error, usually hypermetropic astigmatism, follicular conjunctivitis, and blepharitis will be found. Suitable glasses and the exhibition of iron and arsenic usually suffice to cure the disease.

Tonic Blepharospasm appears as a more or less persistent cramp of the orbicularis, and may be caused by foreign bodies in the conjunctival cul-de-sac or in the cornea, by conjunctivitis, and by various types of keratitis.

In rare instances a persistent cramp of the lid occurs in children, generally in those of poor nutrition, which continues for weeks and even months, and for which there is no obvious cause. When the lids are finally opened, there may be blindness, temporary in character and without changes in the fundus oculi, or associated with definite lesions in the choroid and retina. In the one instance the blindness is probably due to the long-continued exclusion of the rays of light, and in the other to alteration in the coats of the eye from pressure.

Treatment.—As the affection in the large majority of cases partakes of the nature of a reflex originating from an irritation of the peripheral trigeminal fibres, the source of irritation—foreign body, phlyctenule, or fissure at the commissure—must be removed. If the cramp continues, morphine, conium, or gelsemium may be tried. In bad cases section of the supraorbital nerve has been performed.

Ptosis.—In this affection the upper lid droops over the eyeball, and more or less perfectly covers it. It may be congenital or acquired, unilateral or bilateral, and is usually divided into that form of ptosis which is caused by an hypertrophy of the connective tissue or an excessive accumulation of fat, and that variety which depends upon imperfect development of the levator palpebrarum or paralysis of this muscle. Ptosis may also be the result of paralysis of the oculo-motor nerve, and can be caused by injury to the levator of the upper lid.

Cases of constitutional origin—for example, from syphilis or rheumatism—require the usual remedies. The treatment of congenital ptosis, either of the hypertrophic variety or that due to imperfect muscular development, requires an operation.

Lagophthalmos, or an inability to close the eyelids, may result from paralysis of the facial nerve, and also when the globe is pushed forward by a tumor of the orbit, or is prominent as the result of exophthalmic goitre, or protuberant on account of a staphyloma. The affection is referred to because, under certain circumstances, the exposure which the cornea suffers may lead to ulceration, especially if with the facial palsy there exists an involvement of the trigeminal fibres. Under these circumstances the operation of tarsorrhaphy, which consists in uniting the margins of the upper and lower lids in the neighborhood of the external commissure, is indicated.

Symblepharon is really an affection of the conjunctiva, and consists of a cohesion between the eyelids and the ball which may be partial or complete. It generally follows an injury, particularly a burn of the conjunctiva with acid or lime, and may also result from violent inflammations of the conjunctiva. It occasionally occurs as a congenital defect.

Treatment.—If adhesions form, they should be broken down with a probe, and their reattachment prevented by introducing between the lid and the ball a piece of gold-beater's skin or by keeping the cul-de-sac packed with a pledget of lint smeared with boric-acid ointment. If these simple measures fail, then one of the many operations for the relief of symblepharon must be performed.

Trichiasis; Distichiasis.—*Trichiasis* is that affection in which the cilia are turned inward and rub against the ball. It is most commonly caused by chronic inflammation of the border of the lid—for example, blepharitis—and by granular conjunctivitis. The cilia produce much irritation, and may cause an ulceration of the cornea.

When incurved rows of supplementary eyelashes are developed from the intermarginal part of the lid, the affection receives the name *distichiasis*. Sometimes this is congenital, but it also arises under the same circumstances which produce trichiasis.

Treatment.—If the misplaced lashes are not too numerous, they may be removed with cilium forceps, and the procedure repeated when they grow again; but if the affection is extensive, some operation which consists in strangulating or destroying the roots of the incurved lashes, or in which a single or double transplantation of the entire margin of the lid is effected, must be performed.

Entropion.—With or without trichiasis there may be an inversion of the lid. The organic variety follows long-continued granular conjunctivitis, atrophy of the conjunctiva, and diphtheritic ophthalmia. A spasmodic entropion is common as the result of inflammation of the cornea or conjunctiva, or from the

presence of foreign bodies, and is sometimes a marked symptom shortly after birth, owing to an undue activity of the orbicularis muscle.

Treatment.—Spasmodic varieties usually subside by removing the cause. In the event of failure the inverted lid may be drawn outward and held in place by a piece of adhesive plaster attached near the margin of the lid and passing downward on the cheek, or by a piece of gauze fastened with collodion. When there is organic entropion a formal operation must be undertaken for its cure.[1]

Ectropion.—This consists in an eversion of the lid, partially or completely exposing the conjunctival surface. It may occur as an acute affection, especially in children with inflammatory affections of the conjunctiva and cornea. In its organic form, however, the eversion is generally caused by an injury—for example, the laceration of the lid with a sharp instrument—by cicatricial contraction as the result of burns, by chronic disease of the margin of the lid, and by caries of the orbital border or malar bone. A slight eversion of the lid is practically always present in children with facial palsy.

Treatment depends entirely upon the type of the affection. The spasmodic varieties get well with removal of the cause, associated with replacement of the everted lids; mild types are sometimes curable by dilating the punctum lachrymale, but in the organic forms there is no remedy except a formal operation.

Milium.—Milia are common on the eyelids about the age of puberty, and consist of small, yellowish elevations which are due to a distention of the sebaceous glands. They result from improper care of the skin, but often indicate disturbances in the alimentary canal, particularly dyspepsia and constipation. They may be removed by pricking each elevation with a needle and evacuating the contents.

Molluscum Contagiosum, a disease of the sebaceous glands, perhaps of the rete mucosum, and probably of parasitic origin, may develop upon the eyelids. It is generally seen in ill-nourished children, and in asylums sometimes constitutes an epidemic. Each molluscum is a rounded papule about the size of a pea, of a somewhat waxy color, and with a slight depression near its centre.

The treatment consists in incising it and forcing out the contents.

Sebaceous Cysts, as well as Dermoid Cysts, may occur in the eyelids, but are more commonly seen in the upper portion of the eyebrows. Sometimes in the latter situation they adhere to the periosteum and may pass deeply into the orbit. They should be removed by an ordinary dissection.

Injuries of the Eyelids.—The eyelids may receive an incised, lacerated, or contused wound, depending upon the character of the implement which has caused the injury. The treatment does not differ from that of similar injuries elsewhere located, but it is of the utmost importance that scrupulous asepsis should be followed, and accurate adjustment of the lips of the wound effected with fine silk sutures.

Blows upon the lid may cause a *simple œdema* on account of the distention of the cellular tissue with serum.

[1] For the description of operations the reader is referred to systematic works on ophthalmic surgery.

Œdema does not alone result from an injury, but independently of its common association with severe inflammations of the cornea and conjunctiva, appears in renal and cardiac diseases; and one variety, which has received the name *fugitive œdema*, may occur in connection with migraine, and sometimes arises in association with the establishment of the menstrual function, and, again, spontaneously and apparently without cause. In one case which the author has seen with Dr. Louis Starr, in a very young child, it depended upon the circulatory disturbances associated with slight goitre.

In the non-constitutional varieties evaporating lotions—for example, lead-water and laudanum—and removal of the cause, if possible, are the proper remedies.

A *burn of the eyelid*, either by hot water, acid, or caustic, should be treated upon general principles, care being taken to prevent adhesions between the eyeball and lid. One of the very best preparations for soothing the pain of burns is a lotion of carbonate of sodium.

Powder-burns.—The bluish-black specks caused by the implantation of the grains of powder in the skin should be picked out with a fine needle as soon as possible after the injury, and recently Dr. Jackson, of this city, has suggested that each grain may be removed by touching it with a finely-pointed galvano-cautery needle. Afterward the ordinary applications for burns may be applied.

Emphysema of the Lids generally indicates a fracture of the orbit, permitting the escape of air into the cellular tissue through a communication with the ethmoidal or frontal sinus.

If blood collects in the same situation, *ecchymosis of the lid* results. This condition, commonly called "black eye," most frequently follows a blow. It may also occur with fracture of the base of the skull, and occasionally appears in an alarming fashion by the rupture of a small blood-vessel after a violent paroxysm of whooping-cough.

Treatment.—Frequent applications of very hot water, tincture of arnica, lead-water and laudanum, or diluted fluid extract of hamamelis, have some effect in producing absorption of the effused blood. It is useless to attempt to cause absorption of the blood by the application of leeches.

Affections of the Conjunctiva.

Inflammatory diseases of the conjunctiva are exceedingly common in children, constituting about 40 per cent. of the eye cases in hospital practice. The most important group is that described under the general term *conjunctivitis*, which for purposes of description may be conveniently divided into six varieties:

I. Simple Conjunctivitis, generally called *catarrhal* or *muco-purulent conjunctivitis*, is characterized by hyperæmia of the conjunctiva, loss of its transparency, some dread of light, with a feeling of grittiness under the eyelids and a muco-purulent discharge, which may be slight or profuse.

Etiology.—The disease readily passes from one eye to its fellow, and from one subject to another, and in this sense is distinctly contagious. Bacteria are probably the active agents of this contagion. The affection is common in changeable weather, and is often seen in the spring and fall. It may attack perfectly healthy children, but is more common in scrofulous subjects, and is more likely to be implanted in a conjunctiva already hyperæmic or studded with swollen follicles. It may be associated with eczema, erysipelas, impetigo

contagiosa, naso-pharyngeal affections, bronchitis, and rheumatism, and commonly follows or attends the exanthemata. It may further arise from exposure to dust or irritating substances, and is sometimes the result of eye-strain. One form, common in the spring and fall, has received the singularly inappropriate name "pink eye," being really an epidemic catarrhal inflammation probably due to a special micro-organism (Weeks).

Symptoms.—These are—swelling of the lids and slight œdema of their margins; mucous or muco-purulent discharge, which may excoriate the surrounding skin; hyperæmia of the conjunctiva and congestion of the posterior conjunctival vessels, in bad cases associated with œdema of this membrane and small hæmorrhages; and some photophobia, especially if small corneal ulcers are present. The character of the discharge and appearance of the conjunctiva, the free mobility of the iris and lack of change in its color, distinguish it from iritis.

Prognosis is good, cure usually resulting in one or two weeks, but when neglected or when occurring in homes or asylums conjunctivitis of this character may spread with great rapidity and become a stubborn epidemic.

Treatment.—This should be as follows: Removal of the cause in so far as this is practicable; protection of the inflamed eyes with a pair of dark glasses or a shade, but *under no circumstances the application of a bandage or of a poultice in the form of flaxseed, tea-leaves, bread and milk, or scraped potatoes;* prevention of contamination with the discharge through any medium (in homes, etc. the affected inmates should be isolated); scrupulous removal of the secretion, which may be effected by washing the eyes frequently with tepid water and castile soap and irrigating the conjunctival cul-de-sac with the following collyrium:

℞. Boric acid . . . . . gr. xv.
Table salt . . . . . gr. ij.
Distilled water . . . . . f℥j.—M.

When the discharge becomes profuse, the lids should be everted and carefully painted with a small cotton mop or camel's-hair brush dipped in a solution of nitrate of silver (gr. v–f℥j).

The following collyria have also found favor with many surgeons:

Bichloride of mercury (1 : 10,000); alum (gr. iv–f℥j); sulphate of zinc (gr. ij–f℥j); peroxide of hydrogen (diluted one-half or three-quarters); and creolin (1 per cent.). Atropine is generally unnecessary. A saline laxative and tonic doses of quinine are suitable remedial agents in cases which do not present special therapeutic indications.

II. Purulent Conjunctivitis.—This affection, in so far as infants are concerned, is generally described under the name "Ophthalmia Neonatorum."

Etiology.—The infecting material enters the eye from some portion of the genito-urinary tract during the passage of the head of the infant through the birth-canal, or inoculation may be effected shortly after birth; in rare instances it takes place *in utero* when there has been a rupture of the membranes.

The gonococci of Neisser are demonstrable in most of the cases and in all severe forms, and bear the same relation to this disease that they do to gonorrhœa. There is, however, one non-specific variety in which this micro-organism is not present. Therefore a virulent vaginal discharge (gonorrhœal) is not a *sine qua non* of this affection, but it may arise from the introduction of any muco-purulent discharge during birth, while careless bathing and the use of soiled towels or sponges after birth are evident sources of infection.

It is probable that injudicious intravaginal antisepsis with strong solutions

of bichloride of mercury may originate a vaginitis itself capable of inducing one form of ophthalmia neonatorum, and the best obstetricians confine the application of germicidal solutions in uncomplicated labors to the external genitalia. The author is confirmed in this belief by a consultation with Prof. B. C. Hirst.

Boys are more apt to be affected than girls, and inoculation is more likely to occur during retarded labors and with face presentations.

Symptoms.—Ophthalmia neonatorum usually begins on the third day after birth, but may set in sooner, and when it results from secondary infection—for example, from soiled clothes—it begins at a later date. Almost invariably both eyes are affected.

At first there is a slight discharge, which gathers at the corners of the eye, rapidly succeeded by intense injection and chemosis of the conjunctiva, great swelling of the lids, and the free secretion of contagious pus. The swollen lids are at first tense, and the serous infiltration of the bulbar conjunctiva almost hides the cornea, sometimes forming a hard rim around it; the discharge increases and flows out underneath the lids, often being mixed with blood and serum. During the earlier stages the conjunctiva is red and velvety and often covered with flakes of lymph; later it becomes dark red, rough, and easily bleeds. In from six to eight weeks, if unattended, the disease gradually declines and the relaxed conjunctiva is thick and granular-looking, and slowly regains its normal appearance.

The intense chemosis of the conjunctiva strangulates the vessels which supply nutrition to the cornea; hence the vitality of this membrane is threatened, constituting the chief danger of the disease. Ulcers are likely to form, either at the margin or centre, and their tendency is to spread and perforate; or the entire corneal tissue becomes hazy.

The results of perforation are the formation of a *partial* or *complete staphyloma* and *adherent leucoma*, or a *pyramidal cataract*. Even without perforation the ulcers leave scars which, according to their density, are nebulous or leucomatous. In extensive perforation there may be an inflammatory involvement of all the coats of the eye, constituting panophthalmitis, which is followed by shrinking and atrophy of the globe.

Some non-specific cases of ophthalmia neonatorum do not have so violent a course, and present the appearance of an ordinary muco-purulent conjunctivitis. Again, others are analogous to diphtheritic conjunctivitis, and the danger of corneal destruction is even greater than is ordinarily the case.

Prognosis.—This is always grave, but under the guidance of competent medical advice, *if the eye be seen while the cornea is still clear*, except in those examples which assume the diphtheritic type, the case should be brought to a successful termination. The chief fault lies in the indifference of attendants to what seems to them at first a trivial inflammation.

Treatment.—The treatment should meet four indications:

(*a*) During the earlier stages, when the inflammatory swelling of the lids is great, in addition to proper cleanliness the local application of cold is the most useful agent. This should be applied as follows: Upon a block of ice, square compresses of patent lint are laid, which, in turn, are placed upon the swollen lids, and are as frequently changed as may be needful to keep up a uniform cold impression. The length of time occupied with these cold applications must vary according to the severity of the case. Sometimes they may be almost continuously used, and sometimes frequently for periods of half an hour.

(*b*) The discharge should be constantly removed, and, if possible, by a

trained hand. In order to accomplish this, proceed as follows: Gently separate the lids, wipe away the tenacious secretion with bits of moistened lint or absorbent cotton, and irrigate the conjunctival sac freely with an antiseptic solution, care being taken that the point of the pipette does not come in contact with the cornea. For this purpose a saturated solution of boracic acid — which, while it is not germicidal, is still feebly antiseptic and slightly astringent — is the most useful. Bichloride of mercury, one grain to the pint, may also be employed.

(*c*) As soon as the discharge becomes free and creamy, which is very early in the disease, nitrate of silver should be employed; and this drug is *facile princeps* of the local remedial agents. It must be applied as follows: Carefully evert the lids and secure complete exposure of the inflamed tarsal conjunctiva; remove all discharge and flakes of lymph by irrigating the surfaces with the cleansing lotion, wiping away the adherent particles with moistened cotton; carefully touch the area thus prepared with a cotton mop or camel's-hair brush which has been dipped in a solution of nitrate of silver, ten, or at most twenty grains, to the ounce; neutralize the excess with a solution of common salt—a pinch of salt in a cup of water will suffice—and keep applying the saline solution until a clean, red surface is secured; finally, return the lids to their proper position and carefully inspect the cornea before leaving the case, and see that this inspection is made at each dressing of the eye; finally, grease the margins of the lids with pure vaseline, some of which should be introduced within the conjunctival cul-de-sac.

(*d*) Should the cornea become hazy or should a small ulcer form, eserine may be employed in a strength varying from a sixth to a half grain to the ounce, but cautiously, lest it produce iritis. Under the latter circumstance, or if the ulcer be central, atropine is the better drug, and may be used in a strength of from two to four grains to the ounce. Very good results usually follow the use of eserine two, three, or four times during the day, according to the severity of the corneal ulceration, and a drop or two of the atropine solution toward night, with due caution lest the constitutional disturbance from these drugs arise in young infants. If there is corneal haze, indicating low vitality of the membrane, the cold compresses may be replaced by *hot* applications, which should consist of squares of lint wrung out in a slightly carbolized solution of a temperature of 120° F.

The author has thus described the treatment which he has employed many times with success. Among the other solutions which have found favor with surgeons are the following: Alum (eight grains to the fluid ounce);[1] carbolic acid ($\frac{1}{2}$ to 5 per cent. solution); weak solutions of nitrate of silver; alcohol and bichloride-of-mercury solutions; creolin in 1 per cent. solution; peroxide-of-hydrogen solution; permanganate of potassium (1 : 1000), employed in copious irrigations; cyanuret of mercury (1 : 1500), and aqua chlorinata. Many others might be mentioned, but the evidence is not sufficient to warrant their recommendation or even their trial.

While the author does not wish to condemn the use of a *proper strength* (1 : 8000) of bichloride of mercury in the treatment of this disease, because it has often served him to good purpose, he is convinced that in many instances a sense of false security has arisen simply because the drug has been employed and because of its vaunted germicidal properties. Strong solutions of sublimate may occasion cloudiness and even ulceration of the cornea. The success of treatment depends largely upon seeing the case *early* while the cornea

[1] This has recently received fresh endorsement from Mr. Brudenell Carter (London *Lancet*, December 10, 1892).

is still bright, upon the faithfulness of the attendants, and upon assiduous attention to the details of the treatment.

Prophylaxis.—Inasmuch as ophthalmia neonatorum is one of the most fruitful causes of blindness, prophylactic measures are of the utmost importance. All things considered, Crédé's method of treating the eyes of the new-born child is the one which is followed by the best results. This consists in the instillation of two drops of a 2 per cent. solution of nitrate of silver in the eyes of the new-born child, which, as soon as it is expelled from the maternal passages and before the cord is cut, is placed upon its back in the bed, the eyelids carefully cleansed, then parted, and the drug introduced. This instillation, when there is reason to suspect gonorrhœal contagion, should be repeated on the second day. In the mean time, small compresses soaked in a solution of salicylic acid are laid upon the closed lids. Sometimes the instillation of the silver solution causes hyperæmia, which disappears in a few days. In a few instances smart conjunctival hæmorrhage has followed this treatment. The enormous value, however, of this prophylaxis far outweighs the few accidents which have occurred after its use.

Numerous other methods have been employed in the prophylaxis of ophthalmia neonatorum, and most of the antiseptic fluids have had their advocates, particularly carbolic acid, 1 per cent., bichloride of mercury, 1:5000, Van Swieten's solution (corrosive sublimate 1 part, alcohol 100 parts, water 900 parts), and aqua chlorinata, the last drug being especially recommended by Schmidt-Rimpler. On the other hand, many obstetricians are content with painstaking cleanliness during birth and also during childbed, believing that this will reduce the possibility of the disease to a minimum. While this may be true in private practice and in the absence of any suspicious secretion in the maternal passages, Crédé's method or an analogous one ought certainly to be used in hospital practice always and whenever there is the least suspicion of contagion. There is reason to hope that stringent legislative regulations will be formulated to lessen this appalling cause of blindness, but in their absence it is the evident duty of physicians, nurses, and directors of public charities to disseminate among the poorer classes a knowledge of the dangers of this disease and the necessity for prompt treatment. When the disease has developed and is monolateral, the unaffected eye may be protected with a bandage. Attendants should be warned of the danger of contamination.

III. Diphtheritic Conjunctivitis.—This is an exceedingly contagious conjunctivitis, which may arise from a similar case or during the course of a purulent ophthalmia. It may appear in connection with eczema of the face or accompany an acute illness, as scarlet fever or measles. The disease is also seen during epidemics of diphtheria, when it is occasioned by direct inoculation. A comparatively rare affection in America and England, it is common in certain parts of France and in the north of Germany. It is most frequent in children between the ages of two and eight.

Symptoms.—The chief symptoms are swelling of the lids, which become exceedingly hard and board-like; a dull, grayish, false membrane, either discrete or confluent, covers the conjunctival surface. The membrane is often deeply incorporated with the subjacent tissue. The cornea rarely escapes, and destruction of this membrane may take place in twenty-four hours. Even in the mild cases severe ulceration is common.

Treatment.—During the earlier stages cold compresses are proper, to be substituted by hot affusions later on, especially if there be corneal ulceration. The eyes should be frequently cleansed with boric acid or weak solutions of bichloride of mercury, and atropine drops should be instilled if the ulceration

of the cornea is peripheral; but in most instances eserine is the better drug. French physicians warmly recommend the application of lemon-juice and citric-acid ointment, and, on the recommendation of Tweedy, solutions of quinine have been much employed. The internal treatment is that suited to a case of diphtheria, and in the experience of the author, with the few cases which he has seen in the Children's Hospital of this city, the best results were obtained by the administration of bichloride of mercury or calomel, associated with quinine suppositories.[1]

IV. Spring Conjunctivitis (*Fruehjahr's Catarrh*).—This curious form of conjunctival disease is generally seen in children between the ages of five and fourteen years. Its exact cause is unknown. *One of the characteristics of the disease is its return about April*, and its subsidence in the fall and winter, although sporadic cases are seen in almost every month of the year. Sometimes it accompanies the disease known as hay fever.

Symptoms.—The chief symptoms are photophobia, mucous secretion, hypertrophy of the tissues surrounding the limbus of the cornea in the form of grayish nodules, and a pale, dull color of the palpebral conjunctiva, which has been compared to the appearance of a thin layer of milk, together with the formation of large flattened granulations covering the tarsal folds and causing the eyes to droop and give the patient a peculiar, sleepy expression. It must not be confounded with granular lids, from which it is distinguishable by the flat appearance of the granulations and the absence of corneal complications. So far as vision is concerned, the prognosis is good, but the prominent tendency of the disease to return with the early spring and warm weather makes it a difficult disorder to manage.

Treatment.—The eyes should be protected with dark glasses, the conjunctival cul-de-sac freed from the accumulated secretion, which is sometimes quite free, with a lotion of boric acid and salt. When the granulations are prominent the lids may be everted and their surfaces touched with a 20 per cent. solution of boroglyceride or with a strong solution of bichloride of mercury (1:500), this application to be made once a day. In bad cases the actual cautery may be employed to destroy the granulations, or these may be crushed with roller forceps, as in the treatment of granular lids. Internally, some form of arsenic is advisable, preferably Fowler's solution.

V. Follicular Conjunctivitis.—This, as its name implies, is an inflammation in which numerous pinkish, round elevations appear in the conjunctiva, chiefly in the retrotarsal folds, sometimes associated with the symptoms of an ordinary catarrhal conjunctivitis of mild degree. These bodies are tumefied lymphatic follicles, and disappear under treatment without leaving cicatricial changes in the conjunctiva, and the cornea is not involved—points which distinguish the affection from true granular lids. Some authors regard it as an early stage of granular conjunctivitis. The evidence is in favor of a separate classification.

It occurs usually in children and young people, and in its aggravated forms arises under the influence of bad hygienic surroundings in overcrowded schools and asylums. A mild form is common in school-children under good conditions. When neglected, it may become a serious and epidemic disorder.

Treatment.—This consists of improvement of the surroundings, building up of the general health if this is below par, and, locally, boric-acid solution

[1] There is also a true *croupous conjunctivitis* which occasionally attacks children between the first half year of life and the fourth year. It is not contagious, and the cornea generally escapes, and although membrane forms upon the conjunctiva, the lids remain pliant. It is a rare disease, and the distinction between it and true diphtheria of the conjunctiva is not always maintained by authors.

or sublimate collyrium, a salve of sulphate of copper (½ gr. to ʒj), or dusting upon the retrotarsal folds iodoform, aristol, or equal parts of subnitrate of bismuth and calomel. Refractive errors should be corrected. If the disease is at all stubborn, the swollen follicles should be destroyed, preferably with Knapp's roller forceps.

VI. Granular Conjunctivitis (*Trachoma*).—This is a serious form of inflammation in which rounded granulations[1] (trachoma-bodies) form in the conjunctiva, resulting in cicatricial changes in the lids and vascularization and ulceration of the cornea. The disease may be *acute* or *chronic*. It is distinctly contagious.

Although not nearly so common in childhood as in adult life, many cases occur among children, especially of the poorer classes. It is most frequent among the Jews, Irish, Italians, Indians, and inhabitants of the East, but, except in rare instances, is unknown among the pure negroes. Inhabitants of low and damp regions are more liable than those who live on high ground, an altitude of one thousand feet conferring comparative immunity. This predisposition to granular lids is also encouraged by residence in badly-ventilated homes and asylums, where the disease may become epidemic, and by imperfect nutrition, but there is no known constitutional disorder at the bottom of the disease. The essential characteristics of the affection are the "granulations" (trachoma-bodies), sometimes called "follicles," which differ from those seen in follicular conjunctivitis because they may be regarded as pathological new formations. It is probable that the active agent in the production of trachoma and its dissemination is a special micro-organism, the *trachoma-coccus*, but its identity is not clearly established.

Symptoms.—In *acute* granular conjunctivitis, in addition to the phenomena of a violent conjunctivitis, associated with great dread of light, free lachrymation, and later a muco-purulent discharge, the conjunctival papillæ become hypertrophied and there is a liberal growth of roundish granulations in this membrane. This acute type must be distinguished from the exacerbations which are common in the chronic variety of the disease.

In *chronic* granular conjunctivitis there may be a stage of acute inflammation, such as has just been described, but most frequently it appears without such preceding condition. The grayish-white, semi-transparent granulations, often in rows and sometimes resembling the spawn of frogs, develop chiefly in the retrotarsal folds. The most important types are (*a*) papillary trachoma, (*b*) follicular trachoma, and (*c*) mixed or diffuse trachoma. In the papillary and mixed varieties, in addition to the granulations, there is much hypertrophy of the conjunctival papillæ. At first there is little discharge, but as the development of the follicles increases a softening process takes place and the secretion becomes abundant and is extremely contagious. Gradually the stage of cicatrization is reached, which results in the formation of scar-tissue, the cicatrices often lying in characteristic parallel lines, while the lids become indurated and their borders inverted, resulting in conditions which have already been described. In bad cases there is a practical drying up, or *xerosis*, of the conjunctiva, with obliteration of the sulcus.

Sequelæ.—The most important sequels of granular lids have been referred to, with the exception of the vascularization of the cornea, or *pannus*, which is really a form of *vascular keratitis*. It always begins under the upper lid by the development of blood-vessels in the superficial layers of the cornea, often associated with ulceration and opacification of that membrane. This pannus is

[1] These should not be confounded with the granulations of wounds.

partly due to the mechanical effect of the granulations, and partly to a special implantation of the disease in the cornea.

Treatment.—Acute granular conjunctivitis must be managed on the principles already laid down in connection with an acute inflammation of the conjunctiva.

In chronic granulations the object is to promote absorption of these with the least cicatricial change, and consequently the application should never be so caustic as to create scars, which would be worse than those resulting from the natural subsidence of the disease. It would be impossible in this brief description even to refer to the numerous applications which have been made, and the author will hence recommend those which in his own practice he has found most efficacious—namely, (*a*) nitrate of silver, 10 grains to the ounce, during any stage of granular lids when there is much discharge, to be applied in the manner already described; (*b*) strong solutions of bichloride of mercury (1 : 300 or 1 : 500), applied to the everted lids with a cotton mop, associated with frequent irrigation of the conjunctival cul-de-sac with a tepid solution of the same drug, 1 grain to the pint; suitable in practically any stage of granular lids, but especially when there is decided development of the follicles; (*c*) sulphate of copper in the form of a smooth crystal, which is rubbed over the everted lids and well across the retrotarsal folds, useful in any stage except that in which there is much discharge, and particularly valuable in the later periods of the disease; (*d*) boro-glyceride, 20 or 50 per cent., applied in the usual manner to the affected conjunctiva, most valuable after cicatrization has begun. In mild cases an excellent remedy is a solution of tannin and glycerin, 20 or 30 grains of tannic acid to the ounce of glycerin.

Generally, pannus will disappear with the subsidence of the granulations. If it does not or if exacerbations are present, it must be treated after the manner suited to keratitis. (See page 1141.)

Operative interference, except in the acute cases, yields the most satisfactory results in the treatment of granular lids. The best method is expression of the granulations by means of forceps, and of those thus far devised, the one advocated by Knapp, which works on the principle of a roller, is the most valuable. After the lids have been thoroughly rolled the local treatment must be continued, and generally the sulphate-of-copper crystal will then be found useful. The roller forceps, however, are not sufficient in cases of diffuse trachoma. Then the operation called "*grattage*" is much practised. This consists essentially in deep scarifications and rubbing out the trachoma-bodies with a stiff brush which has been dipped in a solution of bichloride of mercury. This last-named method is a vigorous means which should be utilized in selected cases, and for a description of which, and of the many other methods, the reader is referred to systematic treatises on diseases of the eye.

Ecchymosis of the Conjunctiva, which consists of an escape of blood into the meshes of the connective tissue, is particularly interesting in children as the common result of a violent paroxysm of whooping cough, although it may arise under any straining effort. It is also seen with girls at the beginning of the menstrual epoch. The entire conjunctiva may become blood-red. The blood disappears without treatment, although hot compresses seem to hasten its subsidence.

Chemosis of the Conjunctiva is common in various types of conjunctivitis, but it is also a symptom of deeper diseases of the eye; for example, inflammatory affections of the uveal tract. Sometimes it occurs without appa-

rent cause. The œdema may be very great, and the conjunctiva appear like a huge bleb and protrude between the lids. Usually the œdema subsides under the influence of hot compresses and an astringent lotion; for example, a weak solution of alum. If it be very severe, the swollen tissues may be incised.

Tumors and Cysts of the Conjunctiva.—Several varieties of benign tumors and cysts (dermoids) have been described, and among the malignant tumors in children should be mentioned sarcoma, which develops usually at the limbus, and is generally pigmented. The benign growths and cysts can easily be removed. If a sarcoma appears, it may be necessary to extirpate the entire eyeball.

Tubercle of the Conjunctiva, under rare circumstances, occurs as a primary affection in the form of uneven ulcers beset with grayish-red nodules, in which a decisive diagnosis could be made by bacteriological examination.

Pemphigus may attack this membrane. There is a curious form of *atrophy of the conjunctiva* in which the membrane dries up entirely and the borders of the lid become fixed to the ball. This is probably a form of pemphigus, but it has also been described as *essential shrinking of the conjunctiva.* Ordinary atrophy of the conjunctiva following granular lids and diphtheritic conjunctivitis has been referred to.

Injuries of the Conjunctiva.—Burns, especially with lime and acid, are to be feared mostly on account of the symblepharon which they are likely to produce. After a lime-burn the alkali may be neutralized with a weak acid, but usually it is best to speedily flood the eye with a rapid stream of water—for example, from a spigot—and pick off any pieces which the water fails to wash away. Iced compresses may then be applied. Atropine drops should be instilled if there is corneal involvement, and the conjunctival cul-de-sac should be frequently cleansed with a solution containing boric acid and common salt. An acid burn is treated on the same principles, an alkaline wash composed of carbonate of sodium being at first employed. It is usually recommended to drop olive oil on the conjunctiva after a burn, and certainly it can do no harm. A good plan is to incorporate with liquid vaseline some atropine (gr. iv–℥j) and freely introduce this substance.

Phlyctenular Kerato-conjunctivitis (*Phlyctenular Ophthalmia, Strumous, Pustular, and Vesicular Keratitis and Conjunctivitis*).—It is customary to describe phlyctenular conjunctivitis and phlyctenular keratitis as two distinct affections, but as both cornea and conjunctiva are associated in the inflammation, and as the lesion is the same in both cases, it is better to include them under one name.

The disease is characterized by the formation on the bulbar conjunctiva, at the corneal margin, or on the cornea, of small, grayish-white elevations, often called *vesicles* or *pimples*, and usually classified under the generic term *phlyctenules*, associated with injection, lachrymation, and dread of light.

Etiology.—It usually occurs in children before their tenth year, and most frequently in those of strumous constitution. Eczema of the face is frequently present. The use of unwholesome food (sweetmeats, pastry, tea, and coffee), and consequent derangements of the alimentary canal, are predisposing causes: the conjunctival form follows in the wake of scarlet fever and measles. All varieties are more common and more aggravated in warm and moist weather.

There is a direct relation between this disease and various lesions in the nasal fossæ and naso-pharynx (rhinitis, congested turbinals, and adenoid vegetations). It is probable that astigmatic eyes are more liable than those with refractive conditions approaching emmetropia. Several varieties of micrococci have been described, but no definite causal relation has been established.

Symptoms.—In the conjunctival variety the phlyctenules form on the bulbar conjunctiva and especially affect the margin of the cornea. There may be only one or two of them (*single form*), or they may be numerous and scattered everywhere over the membrane (*multiple form*). At first translucent, they soon become turbid and break down. The conjunctival vessels are freely injected.

In the corneal types the phlyctenules, about the size of a millet-seed, appear near the corneo-scleral junction or encircle the margin (*marginal keratitis*), or a single one develops near the border and creeps across the face of the cornea, followed by a leash of blood-vessels (*fascicular keratitis*). There are, in addition, conjunctival hyperæmia, free lachrymation, and intense photophobia. Soon the phlyctenules grow yellow, break down, and ulcers (*phlyctenular ulcers*) are formed, which at first are superficial and may remain so; or, in the more aggravated varieties, they will grow deeper, the surrounding cornea become infiltrated, and perforation may ensue. This is especially apt to occur if a large yellow phlyctenule (*pustular form*) develops just at the margin of the cornea. Relapses are frequent; new phlyctenules form, fresh ulcers result, and, unless the process is checked, the epithelium of the cornea becomes roughened, opaque, and vascular, and *phlyctenular pannus* arises. Almost invariably there is an irritating rhinitis, causing an acrid secretion to flow from the nose and excoriate the lip, while frequently patches of eczema appear around the nares, on the face, or at the auricle.

Treatment.—The extreme photophobia makes it difficult to properly apply local remedies. For this reason the child's head should be taken between the surgeon's knees, while an assistant holds the hands and body. The lids are then separated and the cornea can be gradually coaxed into view. A lid-elevator may be employed, and in very bad cases it is sometimes needful to use ether or chloroform before the necessary inspection of the eye is possible. Cocaine will temporarily relieve the photophobia, but it should never be employed as a constant application where corneal ulceration exists. If the child is of sufficient age, the eyes may be protected with goggles, and under all circumstances the little patient should be encouraged not to bury its head in the bed-clothes or hide in dark corners of the room. Photophobia may be allayed by douching the eyes with cold water, and search should always be made for a fissure at the external commissure, which is apt to keep up the dread of light; if this be present it may be touched with a crystal of blue-stone or the fibres of the orbicularis divided at this point with a sharp knife.

The best possible hygienic surroundings, with strict regulation of the diet, out-door exercise in good weather, and frequent sponge baths with salt water are advisable. Atropine drops, 4 grains to the ounce, should be used until complete mydriasis is obtained, and this dilatation of the pupil should be kept up as long as there is irritation. If there is much discharge, boric-acid drops, with or without the addition of common salt, may be used. In severe ulceration of the peripheral type, eserine (gr. $\frac{1}{2}$ or $\frac{1}{6}$ to the fluidounce) is useful, and may be employed during the day, a drop or two of the atropine solution being instilled at night. After the irritation has subsided yellow oxide of mercury, 1 grain to the drachm, should be employed as a local application, or in its place finely-powdered calomel may be dusted into the eye, provided the patient

is not taking iodide of potash or any preparation of iodine, under which circumstances such practice will result in a violent inflammation of the conjunctiva.

Internally, after the alimentary canal has been prepared by a course of calomel, the most useful drugs are cod-liver oil, iron, quinine, and arsenic.

It is essential in all these cases to treat the nasal conditions which have been described, an excellent routine practice being to spray the parts with Dobell's solution or listerine, and insufflate powdered iodoform, or a mixture composed of camphor, boric acid, and subnitrate of bismuth, or finely-pulverized chlorate of potassium. If, however, adenoid vegetations or hypertrophied turbinated bodies are present, these must be treated on the principles known to nasal surgery. In stubborn cases and with ulcers tending to perforate the measures to be described for treating corneal ulcers will be required. After the subsidence of the disease suitable glasses should be ordered, if the corneal astigmatism is of such character that it can be corrected.

Diseases of the Cornea.

Ulcers of the Cornea.—When the stage of infiltration which accompanies an inflammation of the cornea, or a *keratitis*, fails to end in absorption, and the corneal tissue disintegrates, an open lesion or an *ulcer* results. In children the majority of corneal ulcers which are of primary origin result from the disease which has just been described, and are hence known as *phlyctenular ulcers*. Systematic writers have described a number of other types of ulcer, among which the following varieties may be mentioned:

(*a*) Simple Ulcer.—This, sometimes called "pimple ulcer" when it arises from a phlyctenule, is a small gray infiltration, and may develop from an injury. Frequently it appears right in the centre of the cornea, and as a slightly cone-shaped, gray-white opacity, without much irritation, and is then known as the *small central ulcer of childhood*. It heals, leaving a small scar directly in the axis of vision. It is seen in poorly-nourished children of the strumous habit, and probably represents one of the results of imperfect nutrition. It may heal quickly or develop into a deep ulcer.

(*b*) Deep or Purulent Ulcer.—This is practically described in its title, and is a more aggravated form of the type just described, of yellowish appearance with infiltrated margins, and a tendency to penetrate the layers of the cornea. It may be the result of injury, or may follow certain conjunctival inflammations, or arise because a simple ulceration has been neglected. It heals with a dense white scar.

(*c*) Indolent Ulcers.—Several varieties of these have been described. One is apt to occur in the centre of the cornea—a small shallow lesion with a slightly turbid base and not much injection of the surrounding tissues (*shallow central ulcer*). It is often seen accompanying granular lids. Another variety is called *gouged-out ulcer*, almost without any injection accompanying it, its most common situation being near the corneal margin. These ulcers heal with less dense scars, sometimes only a faint opaque facet remaining (*facetted ulcer*). They are common in anæmic and scrofulous patients, and evidently depend upon failure in the nutrition of the cornea.

(*d*) Sloughing Ulcer.—A sloughing or infecting ulcer is the representative of *purulent keratitis*, and is a more serious grade than the deep or purulent ulcer already noted. This is not so common in children as in elderly people; but at the same time very violent and serious ulcers, which are *serpiginous* or *creeping* in type, arise in children as the result of injury, because the abrasion

thus produced has been infected, probably, with a special form of micro-organism. Not only is there extensive purulent infiltration of the cornea, but also the iris is involved and pus forms in the anterior chamber, and hence the disease is called *hypopyon keratitis*. In like manner, instead of an open ulcer of this character, the pus may be confined within the layers of the cornea, and an *abscess* results, or its superficial layers may burst and there is an open lesion. This also is due to the fact that the area has been inoculated with pathogenic micro-organisms. Some of the most typical examples of abscess of the cornea and hypopyon keratitis occur not only from injuries and neglected ulcers, but with small-pox, scarlet fever, measles, typhus, and typhoid fever.

Treatment.—Everything which tends to improve the surroundings of the patient and to build up his nutrition is indicated. Proper protection of the eyes with goggles is important; whenever possible, out-door exercise is advisable. The remedies already suggested with phlyctenular keratitis are usually needed, care being taken to inquire into possible etiological conditions, which should be met with suitable measures.

Search should always be made for the presence of a foreign body and for irritating, misplaced cilia. The lachrymal passages should be explored to see if they are patent, and the teeth should be examined, and if they are carious the services of a dentist should be secured. The nasal passages and the naso-pharynx should be carefully examined and treated.

In mild cases of simple ulcer atropine drops for a few days, to be followed later by a salve of yellow oxide of mercury (gr. j–ʒj), usually suffice. In severe cases atropine drops may be employed, provided the ulcer is central and if there is any hyperæmia of the iris; if not, eserine in the strength already mentioned may be dropped into the eye three or four times a day, with one or two drops of the atropine lotion at night. The conjunctival cul-de-sac should be frequently irrigated with a mild antiseptic lotion, a saturated solution of boric acid, a weak solution of bichloride of mercury (1:10,000), or aqua chlorinata. These drugs are particularly indicated if there is an associated conjunctivitis with muco-purulent discharge, which should then be treated also on the principles already laid down.

If the ulcer is sluggish, it may be stimulated to heal by the introduction of the yellow-oxide salve. In sloughing ulcers, in addition to the measures already indicated it may be necessary to curette the surface, touch it gently with a solution of nitrate of silver, 10 grains to the fluidounce, or dust upon it finely-powdered iodoform. In many cases the most effectual treatment is the cautery, the point of a galvano- or a thermo-cautery being applied gently but thoroughly to the involved area. In hypopyon keratitis or in abscess of the cornea, paracentesis of the cornea or the section of Sæmisch is sometimes necessary. In any case in which rupture is impending, and there is no contraindication—as, for example, associated catarrhal conjunctivitis—much good may be done by a carefully applied compressing bandage. In any type of corneal ulceration hot compresses are often invaluable, as they aid in healing and preserve the nutrition of the cornea.

The Results of Corneal Ulceration.—Every ulcer is followed by a scar, which may be a mere haze, or *nebula*, a more pronounced spot, or *macula*, or a dense white scar, or *leucoma*. If the cornea has ruptured, the anterior chamber is evacuated, and the iris falls forward and is entangled in the opening. This, then, is an *anterior synechia*, and the scar on the cornea is an *adherent leucoma*. Sometimes an eye of this character becomes quiet; sometimes, however, it cannot resist the intraocular tension and the area bulges forward, forming a *staphyloma*. If there has been an extensive rupture of the cornea and

complete matting of the prolapsed iris with the inflamed and broken-down corneal tissue, the whole cornea protrudes as an opaque elevation, forming a *complete staphyloma.*

Treatment of Sequels.—Slight corneal scars and nebulas may be influenced beneficially by massage of the cornea, aided by the previous introduction of a small particle of Pagenstecher's ointment (yellow oxide of mercury, 1 gr. to the drachm). The dense white leucomas, however, are not thus influenced. If they are central and clear cornea remains at the side, an optical iridectomy may be performed and the scar tattooed with India ink to improve its appearance. After the perforation of an ulcer and prolapse of the iris it is sometimes possible, when recent, to disentangle this with the aid of an instrument and the vigorous use of eserine or atropine, according to the situation of the ulcer. If this fails, staphyloma should be prevented by the vigorous use of a compressing bandage. If, in spite of this, staphyloma, either partial or complete, forms, various surgical measures are indicated, according to the extent of the damage—namely, iridectomy, the operation for partial staphyloma, or, in hopeless cases, evisceration or enucleation.

Infantile Ulceration of the Cornea, with Xerosis of the Conjunctiva (*Kerato-malacia*).—In certain anæmic and badly-nourished children, sometimes after measles, scarlet fever, violent diarrhœa, and other illnesses with great depression of nutrition, the cornea undergoes a rapid destructive ulceration, while the conjunctiva becomes greasy and dry, little flakes of cheesy appearance forming upon its surface. Not only is the destruction of the sight almost inevitable, but most of the infants—for it usually occurs during the first year of life—die, generally of intercurrent pneumonia.

The usual treatment of corneal ulceration is indicated, with an attempt to improve the general condition.

This disease should not be confounded with a type of conjunctival disease known as *xerophthalmos*, in which the same cheesy flakes form and the membrane becomes greasy and dry, and which sometimes occurs as an epidemic with the curious symptom of *night-blindness*, especially in people who have long fasted.

Interstitial Keratitis (*Syphilitic, Parenchymatous Keratitis*).—In this disease, which is an inflammation of the chronic type, a diffuse keratitis, practically always without ulceration, arises, and the cornea gradually becomes thick with haziness until it resembles ground glass, while superficial and deep vascularization accompanies the condition.

It is most often seen between the ages of five and fifteen, and is more frequent in females than in males. A very large percentage of cases is due to inherited syphilis, but it has also been attributed to rachitis, scrofula, malaria, rheumatism, and depressed nutrition. In the syphilitic cases generally some other mark of syphilis is present, particularly Hutchinson's teeth, or evidence of this taint can be acquired from the family history.

Symptoms.—The disease begins with slight ciliary congestion, a few spots of infiltration in the cornea, which speedily develop into the general haze already described, the infiltration being in the interstitial tissue; blood-vessels become thickly set in the layers of the cornea, which in its upper part assumes a dull reddish color. In some types this is so pronounced that a special variety of it is denominated *vascular keratitis.* There are considerable pain and photophobia. Quite commonly iritis develops, and in many instances inflammation of the deeper coats of the eye occurs. It requires from six months to a year and a half before the disease passes through its various stages. Under proper

treatment clearing of the cornea usually takes place, but years afterward careful examination will show traces of the disease, especially in the presence of minute channels through the corneal tissue, indicating the course of the former vessels.

Treatment.—Any irritating application is distinctly contraindicated. Hence it is proper to employ atropine to maintain dilatation of the pupil and prevent iritis; this, if the photophobia be severe, may be combined with cocaine. Hot compresses are agreeable and soothe the inflammation. The eyes should be protected with goggles, and the child encouraged to have outdoor exercise in proper weather. The best general medication is mercury, and, in the opinion of the author, inunction is the preferable method of administration, pushed to the point of tolerance, but never to that of salivation. Subconjunctival injections of bichloride of mercury—two drops of a 1 : 1000 solution—have recently acquired a favorable reputation. After the mercurial course iodide of potassium may be given. Later, bichloride of mercury combined with the tincture of the chloride of iron is suitable, and, if the indications are present, the administration of cod-liver oil, arsenic, and quinine. When all irritation has subsided the remaining opacity may be treated by massage with the yellow-oxide-of-mercury ointment. Iridectomy is sometimes necessary to check the disease or to make a new pupil if a central opacity remains. The disease is stubborn, subject to relapses, and nearly always bilateral, although both eyes are not attacked at the same time, and a long period may elapse between the two attacks.

Injuries of the Cornea.—The most important of these are the ordinary wounds, burns, and scalds; and practically the directions which have already been given in diseases of the conjunctiva are applicable, although, naturally, a wound of the cornea is likely to result in much more serious disaster than one confined to the conjunctiva, because the lens, iris, and even deeper structures, are liable to injury.

After a wound of the cornea the most thorough antisepsis is required. If the iris is prolapsed, it may be seized and cut off and an antiseptic compressing bandage applied. Traumatic iritis is best combated by the frequent use of iced compresses. In severe cases the question of enucleation to prevent sympathetic irritation must be considered.

Foreign Bodies Imbedded in the Cornea must be removed with a spud after the eye has been rendered insensitive with cocaine. Avoidance of much digging at the corneal tissue is desirable. It is necessary to locate small bodies by means of oblique illumination, and much aid is often given by dropping a fluorescine solution into the eye, which colors green the abraded cornea and brings out in contrast the foreign body as a black spot. After the removal of the foreign body it is desirable to thoroughly cleanse the conjunctival cul-de-sac, lest the abrasion be infected and a serious corneal ulcer result. It is equally necessary that the instruments used should be clean in the surgical sense of the word.

Disease of the Iris and Ciliary Body; Sympathetic Inflammation of the Eye.

Diseases of the iris and, indeed, of the entire uveal tract, are comparatively rare in childhood.

Iritis.—This may arise *in utero*, and is then called *congenital iritis*. The child is born with occlusion of the pupil, and actual shrinking of the eyeball may ensue.

It also develops, but infrequently, during the first few months of life (from two to nine months), and in practically all instances is due to inherited syphilis. The ordinary symptoms of iritis are present, but not usually in so severe a type as in adults: fine pericorneal injection, discoloration of the iris, sluggish or immobile pupil, abnormal reaction of the iris to a mydriatic, and the formation of attachments between the pupillary margin of the iris and the capsule of the lens, or *posterior synechiæ*,—symptoms which are absent in conjunctivitis, and hence should always serve as distinguishing features.

Iritis associated with inflammation of the ciliary body, opacity in the vitreous and changes in the choroid, and the deposition of a triangular patch of punctate exudations upon the posterior layer of the cornea (*keratitis punctata, serous iritis, serous irido-cyclitis*) is also seen in young subjects, and, like the preceding affection, may be due to inherited syphilis. Sometimes the iritis which frequently accompanies interstitial keratitis is the most prominent feature of the disease.

Gumma of the Iris and so-called *gummatous iritis* have occasionally been seen in children of syphilitic parents (Alexander, Watson, Mules).

As the age of puberty is approached diseases of the uveal tract become more frequent, and iritis, both plastic and serous, may be seen, the latter especially in girls with disturbances attending the development of the menstrual functions. In one form of iritis lardaceous deposits or nodules appear in the iris, somewhat resembling the small yellowish bodies seen in so-called gummatous (really papular) iritis, constituting the disease called *scrofulous iritis*, which is seen in strumous and anæmic subjects. An insidious form of iritis, associated with vitreous opacities, occurs in the children of gouty parents. The author has seen several examples, and this taint should be suspected in the iritis of boys near the age of puberty.

Tubercles may also appear in the iris (*tubercular iritis*) and constitute a primary tuberculosis.

Finally, an iritis may arise from injury (*traumatic iritis*), and under the influence of infection become purulent (*purulent iritis*)—a type of the disease which has also been described in connection with several infectious diseases (recurrent fever, pneumonia, typhus and typhoid fever, and pyæmia).

Treatment.—This consists in ascertaining the cause and exhibiting suitable remedies, the most important of which are mercury and iodide of potassium. Locally, atropine drops, sufficient to maintain mydriasis, are indicated in practically all cases.[1] In children of a proper age, if there be much pain and inflammatory reaction, leeches may be applied to the temple. Hot compresses are soothing. In traumatic iritis it is proper to employ iced applications, but not in the other varieties of the disease. The ordinary astringent applications are never needed unless there should be associated conjunctivitis. The speedy detection of iritis and prompt use of atropine are important, lest the posterior synechiæ become too strong to be influenced by the drug.

Injuries to the Iris and Ciliary Region; Sympathetic Irritation and Sympathetic Inflammation.—Surrounding the cornea there is a zone about one-quarter of an inch wide, which Mr. Nettleship has very properly called "the dangerous area," and which indicates the ciliary region. Wounds of this portion of the eye, when followed by plastic or purulent inflammation

[1] There are a few exceptions to the rule in serous iritis if the intraocular tension rises.

of the ciliary body (*cyclitis*), are liable to cause functional disturbance of the other eye (*sympathetic irritation*), or serious organic change, which manifests itself as an iritis, irido-cyclitis, or choroido-retinitis, to which the general term sympathetic inflammation or *sympathetic ophthalmitis* is applicable. The eye primarily injured or diseased is usually spoken of as the *excitor*, and the one which becomes involved in the manner just described as the *sympathizer*. Sympathetic inflammation may also be produced by a foreign body which is retained within the eye, and less commonly by corneal ulcers which have ruptured and in which the iris has become entangled, and by shrunken eyeballs—for example, after a panophthalmitis.

Sympathetic irritation is probably a neurosis, and manifests itself in the form of blurred vision, photophobia, tenderness in the ciliary region, and conjunctival hyperæmia. It may be the prodrome of sympathetic inflammation, but this is not necessarily the case, as the latter may arise quite independently, and sometimes insidiously, in one of the forms already noted. If sympathetic irritation is pronounced, the exciting eye should be enucleated, or one of the substitutes for this operation should be performed. This usually suffices to cure the case.

If an eye is so injured that it is sightless and the dangerous region is affected, and especially if a foreign body has entered, enucleation should be performed in order to prevent sympathetic inflammation, because when this has once begun enucleation is often without avail and both eyes may be lost; or indeed, the exciting eye may sometimes be the better one in the end, provided the original injury was not so great as to destroy its sight.

It is impossible in the space here allowed to do more than refer to this most important subject, and for the rules governing the treatment of injuries of the ciliary region and sympathetic inflammation, the reader is referred to systematic treatises on diseases of the eye. Sympathetic inflammation is more apt to occur in children and young people than in adults, and may arise as early as two weeks after the injury or be postponed for years.

Diseases of the Lachrymal Apparatus and Orbit.

Inflammation of the Lachrymal Gland (*Dacryoadenitis*) is an uncommon affection, and may be either acute or chronic, a lobulated swelling appearing at the upper and outer part of the eyelid, associated with chemosis of the conjunctiva. Sometimes suppuration occurs, and an abscess points upon the skin or in the conjunctiva. The chronic form has been seen among scrofulous children, and may follow an injury or diseases of the conjunctiva. In acute cases warm applications should be applied to encourage suppuration, and the pus evacuated by an incision through the conjunctiva. In chronic cases appropriate internal remedies are the various preparations of iodine, and locally iodide-of-cadmium ointment may be applied over the swollen gland.

Diseases of the Lachrymal Sac and Nasal Duct.—The universal symptom of almost every form of disease of this region is an excessive secretion of tears, or *epiphora*. Acute inflammation of the sac, which is not uncommon in children, is known as *dacryocystitis*. The sac becomes distended with secretion, which may be catarrhal or purulent, forming a little swelling in the region of the lachrymal sac, pressure upon which causes the contained fluid to exude from the puncta lachrymalia. Occasionally this inflammation is very acute and assumes a phlegmonous type, the surrounding connective tissue becoming infiltrated with purulent material, while a brawny swelling spreads

over the face. Usually the *lachrymal abscess* under these circumstances points below the tendo oculi, where it may rupture and the opening become surrounded by pouting granulations. Stricture of the nasal duct generally precedes these inflammations of the sac, but in many instances there is no true stricture, but simply a swelling of the lining membrane.

A *fistula of the lachrymal sac* may be congenital or may result from the failure of a rupture of the lachrymal sac to heal. The little opening which generally leads into the sac appears about half an inch below the punctum or further outward along the lower orbital border, and can generally be detected by the presence of a drop of fluid at its mouth.

The causes of diseases of the lachrymal sac and duct are various. Dacryocystitis has been noted a great many times in infants, sometimes shortly after birth and apparently without cause. A great many cases are due to an inflammation which starts in the nose or naso-pharynx, and hence it is not uncommonly seen after measles, scarlet fever, and small-pox. Other cases are due to inherited syphilis and disease of the bones (periostitis and caries) and to traumatism.

Treatment.—A lachrymal abscess, if it is pointing in the manner already described, should be opened with a sharp scalpel, and the sac and abscess-cavity frequently syringed with bichloride of mercury, peroxide of hydrogen, or blue pyoktanin (1:1000). The cavity may be packed with iodoform gauze and allowed to heal by granulation. Sometimes it is possible to effect a cure by dilating the punctum and irrigating the sac through the natural passages. If there is a stricture, positive and cicatricial, the canaliculus should be split, the stricture divided, and probes passed; but it is extremely desirable to avoid mutilating the punctum and the canaliculus if it is possible to effect a cure without it. Naturally, all cases require intranasal treatment on account of the common association of disease in this region, particularly rhinitis, hypertrophied turbinals, and deflections of the septum. A fistulous communication into the sac may be cured by freshening the edges and closing it or by the use of the galvano-cautery. Generally, however, capillary fistulas may be allowed to remain undisturbed. A judiciously applied pressure bandage will sometimes permanently close up one of these openings. Internally, iron, cod-liver oil, and mercury are indicated, according to the general conditions which may be present.

Diseases of the Orbit.

Periostitis.—Either acute or chronic periostitis, which may be due to syphilis, scrofula, tuberculosis, or injuries, sometimes attacks the margin of the orbit, causing localized pain, injection and chemosis of the conjunctiva, swelling of the lids, and protrusion of the eyeball. *Caries of the orbit* occurs quite frequently in children, and is situated nearly always at the margin of the orbit. It may be due to syphilis, scrofula, tuberculosis, or to an injury, and presents practically the same symptoms as those which occur with periostitis. A probe will detect the carious condition of the bone. Great deformity of the lid (ectropion) is not uncommon as the result of this disease.

Treatment.—The treatment consists in the use of the proper constitutional remedies and the surgical measures which are suited to the treatment of periostitis and caries.

Cellulitis of the Orbit (*Phlegmon of the Orbit*).—Phlegmonous inflammation of the cellular tissue of the orbit, producing in its acute variety

exophthalmos, limitation of the movements of the eye, swelling and œdema of the lids, and considerable hyperæmia and chemosis of the conjunctiva, together with decided constitutional disturbances—chills and fever—may occur in children from a variety of causes. The most common are caries of the orbit, septic phlebitis, injuries, and inflammations of the eye which result in panophthalmitis. Sometimes the disease occurs in infants a very short time after birth.

Treatment.—In addition to proper supporting measures and frequently changed hot compresses, an incision should be made, preferably from the conjunctiva, which secures the evacuation of the pus at as early a moment as possible. Proper drainage must afterward be secured, and the case treated upon the general principles which govern the management of purulent inflammations.

Morbid growths are not uncommon in the orbit, either because an intraocular tumor (sarcoma or glioma) has ruptured and invaded the orbit, or as primary growths—namely, the various forms of sarcoma.

Simple and compound cysts are also seen, and, under rare circumstances, a pulsating exophthalmos due to arterio-venous aneurism.

Bleeding in the orbit has sometimes been observed in new-born children, and also occurs in hæmophilia, scurvy, and occasionally in violent attacks of whooping-cough.

Congenital Cataract.

A certain number of infants are born with *complete cataract*, which is usually white or bluish-white in color, and may readily be detected even without instruments of precision. The eye may be otherwise healthy, or there may be associated with it other congenital anomalies and diseases of the choroid, retina, or optic nerve.

Treatment.—The treatment of complete congenital cataract consists in discission, and the patient is ready for operation after the completion of the first dentition; indeed, it is advisable to operate as early as possible, so that the retina may receive the stimulus afforded by the rays of light, and that the sense of sight may thus be educated.

In addition to the complete congenital cataracts, there are numerous varieties of partial cataract which occur in infants and children, of which the most important are: (*a*) *Zonular or Lamellar Cataract;* (*b*) *Central Cataract;* and (*c*) *Pyramidal or Polar Cataract.* The acquired anterior polar cataracts which develop in infancy are due, as has already been explained, to perforating corneal ulcers, especially during ophthalmia neonatorum.

Treatment.—In some of these cases the treatment is practically without avail; in others, particularly in zonular cataract, either iridectomy, discission, or sometimes extraction, may be practised.[1]

The Refraction of the Eye in Childhood.

The most important study of the refraction of the human eye, made from a careful study of the recorded examinations of the eyes of school-children,

[1] Those interested in congenital cataract and its numerous varieties should consult Professor Michel's article in Gerhardt's *Handbuch der Kinderkrankheiten*, Fünfter Band, Zweite Abtheilung. Tubingen, 1889; and Picqué, *Anomalies de Développement et Maladies congénitales du Globe de l'Œil*, Paris, 1886.

was published by Dr. B. Alexander Randall in the *American Journal of the Medical Sciences*, in 1884. From this author's investigations we know that myopia scarcely ever occurs in infancy and is very infrequent before the beginning of school-life; that hypermetropia, or far-sightedness, is the preponderating condition of refraction in infancy and early childhood, and that there is but little reduction in this proportion even during the first years of school-life; that astigmatism is common, and that a measurable degree of it is found in the majority of ametropic eyes; and that the approximately emmetropic or normal eye is infrequent at all ages, and probably at no time exceeds more than 10 per cent.

The great frequency of hypermetropia and hypermetropic astigmatism in children is responsible for a number of the inflammatory conditions which have already been described, particularly blepharitis, and slight conjunctivitis, as well as hyperæmia of the external and internal coats of the eye. Moreover, it is well established that fully 50 per cent., if not more, of the headaches of functional origin which occur in school-children are due to eye-strain, which in its turn is the result of the refractive anomalies which have been mentioned. Not only is headache commonly caused by hypermetropia and astigmatism, but they also contribute to the existence of a variety of so-called reflex neuroses—habit chorea, chorea itself, night-terrors, irritability of disposition, and general nervousness. While the influence of eye-strain in these respects has sometimes been grossly exaggerated, in the sensitive organism of a growing child it is very frequently one of many factors which foster and aggravate these affections, and the evident indication in the investigation of all functional headaches and nervous diseases is the proper examination of the eyes, and in children of suitable age the prescription of glasses to neutralize the refractive anomalies.

It is not always necessary to condemn a child to glasses for the remainder of his life because he happens to be somewhat hypermetropic, and very often a temporary use of spectacles will bridge him over until he has gained sufficient strength to control the symptoms induced by slight accommodative strain. Glasses should not be ordered unless proper examination has demonstrated their real necessity. Judicious hygiene, quitting school, and perhaps the use of tonics, will often relieve symptoms which are inaccurately ascribed to eye-strain simply because emmetropia is not present.

Strabismus, or Squint.

In general terms, strabismus includes those conditions in which the visual axis of one eye is directed away from the point of fixation.

Squint may be *convergent*—that is, the visual line of one eye deviates inward and crosses that of the sound eye at some point nearer than the object fixed; or *divergent*—that is, the visual line of one eye fixes the object, while the visual line of the other eye fails to intersect that of its fellow at the point of fixation. More rarely there is an *upward* or a *downward* squint. So far as children are concerned and for the purpose of the present paragraph, convergent strabismus is the most important. This may be either *concomitant*—that is, the squinting eye is able to follow the movements of the other eye in all directions, or *paralytic*—that is, there is limitation of movement in the direction of the action of the affected muscle.

Concomitant Convergent Squint.—This is the ordinary "crossed eye" of children, and usually begins between the third and fourth years of life. It may be either *permanent* or *periodic*, and the last-named variety may

affect one eye alone or each eye in turn; that is, it is either *monolateral* or *alternating*.

There are numerous causes of concomitant squint, to which only a brief reference can be made. The most important of these is a disturbance of the relation which exists between the power of accommodation of the eyes and their power of convergence, which is caused by errors of refraction—in convergent squint, usually by hypermetropia, in divergent squint, generally by myopia. Squint may also be caused by a disparity in the length or thickness of opposing muscles; for example, the internal rectus muscle may be strong and well developed, while the external rectus is flat and poorly developed. Quite commonly the squinting eye is very amblyopic, and this has been regarded as a cause of convergent squint. This amblyopia, according to one theory, is due to lack of use on the part of the squinting eye, and, according to the other, depends upon imperfect development of the visual centres; that is to say, the amblyopia in the squinting eye is congenital. There is a widespread popular belief that convergent squint may be brought about by fright or by imitation or by looking at some object hung in an oblique direction. These causes, of course, never obtain. Squint, however, is quite commonly first noticed in children after an acute illness—for example, scarlet fever, measles, diphtheria (which may cause one form of paralytic squint), or very depressing illnesses—cholera infantum and similar conditions. These, by weakening the system, determine a strabismus, the conditions for the production of which are already present in the eyes of the child.

Concomitant strabismus must be distinguished from a paralytic strabismus, which may be caused by syphilis, rheumatism, diphtheria, poisons, and, especially in children, by diseases of the base of the brain—for example, tubercular meningitis—by observing that in concomitant strabismus the squinting eye follows the movements of the other eye in all directions; that the secondary and primary deviations of the eye are equal; that double vision is extremely uncommon; and that there are usually considerable degrees of refractive error. In paralysis of an ocular muscle there is limitation of movement of the affected eye in the direction of the paralyzed muscle; the secondary deviation (*i. e.* the deviation of the sound eye, while the affected eye "fixes" an object held about one foot from it) is greater than the primary deviation; double vision is the rule; and there is no special relation to refractive errors. Many of the differential points are difficult to determine in young children, although usually it is possible to elicit that which compares the movements of the eyes.

Treatment of Concomitant Convergent Strabismus.—This may be divided into the mydriatic treatment, the spectacle treatment, and the operative treatment. In very young children who begin to squint good results will sometimes follow the use of a weak solution of atropine—for example, a half or one grain to the fluidounce—continued for long periods of time, just sufficient being introduced into the conjunctival sac to maintain mydriasis and keep the ciliary muscle paralyzed. As soon as the child is of sufficient age the refractive error should be carefully neutralized by means of spectacles. In many instances of periodic squint properly adjusted spectacles will produce a cure, and the effect of the treatment is in direct ratio to the youth of the patient. In the event of failure the eyes may be straightened, either by tenotomy of one or both internal recti, or tenotomy combined with advancement of the external rectus. It is not advisable to operate upon a case of convergent strabismus before the sixth year; in fact, many of the cases do better if the time of operation is postponed to a later period than the one

just mentioned. It is also never proper to operate upon children, even if there is very considerable amblyopia of one eye, until the spectacle treatment has been given a faithful trial. For the method of performing tenotomy and the rules which govern the expediency and character of the operation the reader is referred to systematic treatises on diseases of the eye.

INDEX.

A.

Abdomen, distention of, 14
causes of, 14
diagnosis of, 14
in ascites, 14
in peritonitis, 14
examination of, 13
in disease, 13
inspection of, 13
palpation of, 14
percussion of, 14
in health, 13
protuberance of, in rachitis, 342
scaphoid, causes of, 14
tenderness of, diagnosis of, 14
Abdominal pneumonia, 888
tenderness in variola, 184
Abscess after vaccination, 195
ischio-rectal, 604
marginal, 603
of brain, 632
diagnosis of, 634
from meningitis, 634
duration of, 633
etiology of, 632
in etiology of headache, 722
pathology of, 632
prognosis of, 634
rupture of, 634
symptoms of, 633
treatment of, 634
of cornea, 1139
of eyelid, 1122
of lachrymal gland, 1143
of lachrymal sac, 1144
of liver. See *Hepatitis, suppurative.*
of lobule of ear, 1104
of lung, 895
after croupous pneumonia, 889
following broncho-pneumonia, 880
prognosis of, 895
rupture of, into bronchus, 895
surgical treatment of, 895
temperature in, 895
treatment of, 895
perinephritic. See *Perinephritic abscess.*
perityphlitic, 525
retro-pharyngeal. See *Retro-pharyngeal abscess.*
Abscess, tuberculous periumbilical, 114
Abscesses, cutaneous, with eczema, 1045
Abscission of tonsils, 439
Acarus scabiei, 1098
Accumulation, fæcal, diagnosis of, 14
Acetanilide. See *Antifebrin.*
in tuberculosis, 126
Aceton in diabetic urine, 972
Aching of limbs in chicken-pox, 179
Acid-lemonade in cholera, 266
Acne, 1037
Aconite in acute tubal nephritis, 987
in broncho-pneumonia, 884
in peritonsillar abscess, 437
in scarlet fever, 169
in variola, 188
Acorion Schoenleinii, 1093
Acromegaly, 690
diagnosis of, from gigantism, 692
from myxœdema, 692
from pulmonary osteo-arthropathy, 692
pathology of, 692
symptoms of, 691
treatment of, 693
Acute ascending paralysis. See *Paralysis, Landry's.*
gastritis. See *Gastric catarrh, acute.*
nephritis in etiology of chronic tubal nephritis, 990
Adenitis, cervical, tubercular, 107
in scarlet fever, 164
Adenoid vegetations. See *Naso-pharyngeal adenoid hypertrophy.*
Adenoma of umbilicus, 591
Adenomo-sarcoma of kidney, 1007
Æstivo-autumnal fevers, 328
diagnosis of, 331
from tuberculosis, 331
parasites of, 323
Afanassiew's bacillus, 204
Age in etiology of acute endocarditis, 949
of chicken-pox, 179
of chlorosis, 378
of chorea, 756
Age in etiology of croupous pneumonia, 885
of diphtheria, 274
of erysipelas, 244
of intussusception, 534
of measles, 142
of progressive pernicious anæmia, 381
of rheumatism, 367
of tumors of kidney, 1006
of typhlitis, 526
of whooping-cough, 203
in prognosis of rheumatism, 372
of tracheotomy, 294
of whooping-cough, 209
of occurrence of rachitis, 338
of onset of infantile cerebral palsies, 652
Agenesis corticalis, 657
Agoraphobia, 704
Agraphia, 661
Alæ of nose, dilatation of, in broncho-pneumonia, 878
Albinism, 1079
partial, 1079
Albumin in acute tubal nephritis, 983
in chronic interstitial nephritis, 998
in chronic tubal nephritis, 991
Albuminoids in milk, 46
Albuminuria after epilepsy, 751
chronic, in etiology of amyloid kidney, 996
in diabetes insipidus, 977
in diabetes mellitus, 972
in diphtheria, 278
in erysipelas, 247
in etiology of incontinence of urine, 970
in malaria, 330
in simple atrophy, 522
in splenic anæmia, 385
in stone in bladder, 981
Albuminuric retinitis in chronic interstitial nephritis, 998
Alcohol. See *Stimulants.*
in bronchitis, 905
in broncho-pneumonia, 883
in cholera, 268
in chronic intestinal indigestion, 487
in croupous pneumonia, 890

Alcohol, indications for, 36
in diphtheria, 283
in epidemic cerebro-spinal meningitis, 235
in influenza, 241
in mucous disease, 475
in peritonitis, 583
in rheumatism, 373
in scarlet fever, 170
in typhoid fever, 229
in variola, 189
Alcoholism in etiology of cirrhosis of liver, 574
of hysteria, 729
Alexia, 661
Algid stage of cholera, 262
state in acute milk infection, 492
Alkalies in diabetes mellitus, 976
in mucous disease, 477
in rheumatism, 373
Allingham's method in prolapse of rectum, 607
Almond-flour in diabetes, 974
Alopecia areata, 1080
diagnosis of, 1080
from ringworm, 1080
etiology of, 1080
prognosis of, 1080
syphilitic, 136
treatment of, 1081
Alternate heart-beat, 960
Altitude in etiology of granular conjunctivitis, 1134
in tuberculosis, 124
Alum in ophthalmia neonatorum, 1131
Alveolar sarcoma of kidney, 1007
Amaurosis in hydrocephalus, 620
Amblyopia in erysipelas, 249
in hysteria, 734
Ametropia in etiology of blepharitis, 1123
Amimia, 661
Ammonia in functional affections of heart, 961
preparations in typhoid fever, 229
Ammoniaco-magnesian-phosphate calculus, 1010
Ammonium carbonate in broncho-pneumonia, 883
in diphtheria, 283
chloride in bronchitis, 903
in cirrhosis of liver, 576
in congestion of liver, 567
in jaundice, 564
in malignant measles, 152
in measles, 151
salicylate in rheumatism, 372
urate calculus, 1010
Amœba coli, 506
dysenteriæ, 506
dysenterica in pus from liver, 558
Amussat's operation, 596
Amygdalitis, follicular. See *Follicular amygdalitis.*
Amyl nitrite as a cause of hæmaturia, 964
in asthma, 933
in epilepsy, 753
Amyloid disease of kidney, 996
etiology of, 996
morbid anatomy of, 996
prognosis of, 996
treatment of, 997
Anadenia of stomach, 463
Anæmia, 376
as a cause of incontinence of urine, 969
definition of, 376
following acute nephritis, 989
following rheumatism, 370
in acute endocarditis, 950
in chronic tubal nephritis, 991
in functional heart affections, treatment of, 961
in heart-disease, treatment of, 956
in hereditary syphilis, 134
lymphatic, 386
diagnosis of, 388
from pseudo-leukæmia, 388
from tubercular adenitis, 388
etiology of, 386
morbid anatomy of, 387
prognosis of, 388
symptoms of, 386
treatment of, 388
progressive pernicious, 380
diagnosis of, 383
etiology of, 381
morbid anatomy of, 382
prognosis of, 383
symptoms of, 381
treatment of, 383
secondary, 376
diagnosis of, 377
from chlorosis, 377
from pernicious anæmia, 377
from splenic anæmia, 377
etiology of, 376
prognosis of, 377
symptoms of, 377
treatment of, 377
splenic, 384
diagnosis of, 385
from amyloid infiltration of spleen, 385
from enlarged kidney, 386
from leukæmia, 385
etiology of, 384
morbid anatomy of, 384
prognosis of, 386
spleen in, 385
Anæmia, splenic, symptoms of, 385
treatment of, 386
Anæmias, primary, 378
Anæmic headache, 723
murmurs in chronic tubal nephritis, 991
Anæsthesia dolorosa, 802
in acromegaly, 692
in acute spinal leptomeningitis, 780
in cerebro-spinal meningitis, 233
in hereditary ataxia, 818
in hysteria, 733
in Raynaud's disease, 821
in tumors of spinal cord, 802
Anæsthetics in tracheotomy, 297
Analgesia in tumors of spinal cord, 802
Anastomosis, lateral, in congenital malformations of intestines, 593
in intussusception, 539
Anatomy of urinary organs in children, 1017
Anderson's dusting powder, 1039
Angina in rubella, 177
in scarlet fever, 160, 162
secondary, in rubella, 177
Angioma of rectum, 609
pigmentosum et atrophicum. See *Kaposi's disease.*
Animal broths in subacute milk infection, 499
Animals, experimental production of rachitis in, 340
Ankle-clonus in hereditary ataxia, 817
Anomalies of auriculo-ventricular orifices, 942
of valve-segments, 944
Anorexia, hysterical, 735
in chicken-pox, 179
in measles, 144
in rubella, 176
in typhoid fever, 228
in vaccinia, 194
Anterior fontanelle, ossification of, 13
region of neck, anatomy of, 292
Antifebrin in diabetes insipidus, 978
in diabetes mellitus, 976
in tuberculosis, 126
Antihygienic conditions in etiology of rachitis, 339
Antipyretics in erysipelas, 251
in measles, 153
in tuberculosis, 126
in variola, 189
Antipyrine in acute follicular tonsillitis, 438
in diabetes insipidus, 978
in diabetes mellitus, 976

Antipyrine in epilepsy, 753
in migraine, 720
in pyrexia of broncho-pneumonia, 884
in tuberculosis, 126
in whooping-cough, 212
Antisepsis in treatment of new-born, 75
Antiseptic alkaline solution, 432
Antiseptics in dysentery, 510
in subacute milk infection, 499
intestinal, in pernicious anæmia, 384
Antitoxines of diphtheria, 288
Anuria, 967
intermittent, in hydronephrosis, 1002
Anus, diphtheria of, 603
diseases of, 600
fissure of, 602
occlusion of, complete, 594
stricture of, 603
syphilitic affections of, 600
vegetations or warts of, 601
Aorta, stenosis of, 944
Aortic obstructive murmur, 954
regurgitant murmur, 955
regurgitation, 955
prognosis of, 956
stenosis, 954
prognosis of, 956
Apex pneumonia, 886
Apex-beat, altered position of, in disease, 15
position of, in infant, 15
Aphasia, 661
during acute gastric catarrh, 460
etiology of, 662
from hereditary syphilis, 663
in infantile cerebral palsies, 653
Aphonia due to ascarides, 543
in hysteria, 735
Aphtha, 415
Aphthæ, Bednar's, 416
in simple atrophy, 521
Aphthous ulcer, 416
Apnœa, physiological, 76
Apomorphine in broncho-pneumonia, 882
Apoplexy neonatorum, 74
pulmonary, in new-born, 75
Apparatus for hot-air bath, 986
Appendicitis, 525
operation for, after convalescence, 532
operations for, 530
Appendix, diseases of. See *Cæcum and Appendix.*
in congenital hernia, 532
Appetite in chronic gastric catarrh, 465
in chronic intestinal indigestion, 484
Appetite in chronic peritonitis, 584
in simple atrophy, 521
Arrhythmia, 960
Arrow-root, value of, 22
Arsenic bromide in diabetes mellitus, 976
Arsenic in childhood, 36
in chorea, 763
in chronic intestinal indigestion, 487
in chronic malaria, 334
in convalescence from variola, 190
in diabetes mellitus, 976
in eczema, 1049
in leukæmia, 392
in lymphatic anæmia, 388
in pernicious anæmia, 383
in psoriasis, 1057
in pulmonary emphysema, 926
in purpura hæmorrhagica, 399
in secondary anæmia, 378
in splenic anæmia, 386
in tuberculosis, 125
Arterial stenosis in typhoid fever, 222
tension, increased, in chronic interstitial nephritis, 998
trunks, transposition of, 944
Artery, external carotid, ligation of, 443
Arthritis in scarlet fever, 164
Arthropathies in syringomyelia, 813
Arthrospores of Hüppe, 255
Artificial feeding, 21
in etiology of chronic intestinal indigestion, 484
of gastric catarrh, 457
foods, chemistry of, 47
Asafœtida in constipation, 516
in croupous pneumonia, 890
in tympany of typhoid fever, 228
in whooping-cough, 211
Ascaris lumbricoides, 540
diagnosis of, 544
habitat of, 541
in cystic and common bile-ducts, 543
method of infection by, 542
ova of, 541
symptoms of, 542
treatment of, 544
Ascites, 587
diagnosis of, 588
etiology of, 587
in cirrhosis of liver, treatment of, 577
pathology of, 588
physical examination in, 588
prognosis of, 589
symptoms of, 588
Ascites, treatment of, 589
Asphyxia from delayed labor, 76
local, 821. See, also, *Raynaud's disease.*
of the new-born, 75
causes of, 76
complications of labor causing, 76
electricity in, 80
oxygen in, 80
prognosis in, 77
prophylaxis of, 77
recovery after, 77
symptoms of, 76
tracheotomy for, 80
treatment of, 77
partial, causes of, 82
Aspiration in hydronephrosis, 1003
in pleural effusion, 918
Astasia-abasia, 734
Asthma, bronchial, 928
diagnosis of, 931
from bronchitis and pneumonia, 931
from cardiac asthma, 932
from emphysema, 932
from obstructive dyspnœa, 931
from pleuritic effusion, 932
from pulmonary œdema, 932
from spasm of diaphragm, 932
from uræmic dyspnœa, 932
etiology of, 928
pathology of, 929
physical signs in, 931
prognosis of, 931
symptoms of, 930
theories regarding nature of, 929
treatment of, 932
Millarii,
rachiticum,
thymicum Koppii. See *Laryngismus stridulus.*
uræmic, treatment of, 995
Astigmatism, 1146
in etiology of phlyctenular keratoconjunctivitis, 1137
Astringents in subacute milk infection, 499
Astrophobia, 704
Ataxia, hereditary, 815
diagnosis of, 819
etiology of, 815
morbid anatomy of, 817
symptoms of 817
treatment of, 819
with tumors of spinal cord, 803
Atelectasis during bronchitis, 899

Atelectasis in whooping-cough, 207
post-natal, 871
diagnosis of, 873
from acute miliary tuberculosis, 874
from pleuritic effusion, 874
from pneumonia, 873
etiology of, 871
pathology and morbid anatomy of, 871
physical signs of, 873
prognosis of, 874
symptoms of, 872
treatment of, 874
Athetoid affections in idiots and imbeciles, 694
Athetosis, 694
diagnosis of, 696
from post-hemiplegic chorea, 696
etiology of, 695
in infantile cerebral palsies, 654
pathology of, 695
prognosis of, 696
symptoms of, 694
treatment of, 695
Atresia ani urethralis, 599
vaginalis, 598
vesicalis, 598
congenital, of auditory meatus, 1109
of pulmonary orifice and artery, 943
Atrophies of skin, 1079
Atrophy in acute spinal leptomeningitis, 780
muscular, in hereditary ataxia, 818
of conjunctiva, 1136
simple, 519
bathing in, 523
diagnosis of, 522
from syphilis, 522
from tubercular meningitis, 522
from tuberculosis, 522
etiology of, 519
morbid anatomy of, 520
prognosis of, 522
symptoms of, 521
treatment of, 523
Atropine in atelectasis, 875
in interstitial keratitis, 1141
in night-sweats, 126
in ophthalmia neonatorum, 1131
in phlyctenular kerato-conjunctivitis, 1137
in simple corneal ulcer, 1139
Attenuants, dextrinized, 50
in artificial feeding, 25
Attenuation, barley-water in, 50
gelatin in, 50
oat-meal water in, 50
of milk, 50
Attic, tympanic, inflammation of, 1113
Attitude in pseudo-hypertrophic paralysis, 769
Auditory canal, caries of wall of, 1109
direction of, in infancy, 1111
Aura in epilepsy, 749
in hysteria, 730
Auricle, congenital malformations of, 1104
lesions of, from ear-piercing, 1104
minuteness of, 1104
position of, in diagnosis of mastoid involvement, 1114
supernumerary, 1104
Auricular glands, posterior, in rubella, 177
Auriculo-ventricular orifices, anomalies of, 942
Auscultation of chest, 15
in emphysema, 15
in pleurisy, 15
in pneumonia, 15
of heart, 16
Auvard's incubator, 80

B.

Bacilli in meconium, 488
of pseudo-diphtheria, 275
Bacillus in bronchitis, 898
in measles, 142
of cholera. See *Spirillum choleræ Asiaticæ.*
of foot-and-mouth disease of cattle, 415
of Friedländer in croupous pneumonia, 886
in broncho-pneumonia, 876
of influenza in croupous pneumonia, 886
of Klebs-Loeffler, 274
of Letzerich, 398
of Lustgarten in syphilis, 127
of typhoid fever, 215
parotidis, 198
scarlatinæ, 158
tuberculosis, 95
anatomical changes produced by, 101
biology of, 96
distribution of, 96
in broncho-pneumonia, 876
in fibroid phthisis, 936
in lupus vulgaris, 1083
in pleural effusion, 912
in urine, 105
method of staining, 95
tussis convulsivæ, 204
Backache in variola, 184
Backward children, 670
Bacteria, absence of, in milk, 39
Bacteria in acute milk infection, 491
in diarrhœa, varieties of, 470
in stomatitis gangrenosa, 421
in stool of healthy infant, 470
in tubercular meningitis, 627
multiplication of, in milk, 39
presence of, in milk, 39
toxicogenic, in milk infection, 488
Bacterium coli commune, 470
in normal stools, 488
fœtidum in bromidrosis, 1037
in parotitis, 198
lactis aërogenes, 470
in normal stools, 488
Ball's incision, 596
Bandage, abdominal, for infants, 34
Barley-water, preparation of, 23
"Barrel-shaped" chest, 448
Basham's mixture in ascites, 589
Bath, permanent, Winckel's, 80
temperature of, in childhood, 33
in infancy, 33
the cold, 33
the cooled, 33
the hot, 33
Bathing, 18
frequency of, 32
hour for, 33
in chronic gastric catarrh, 466
in hot weather, 33
in rachitis, 359
in simple atrophy, 523
Baths in broncho-pneumonia, 884
in croupous pneumonia, 890
in eclampsia, 745
in insanity, 708
in laryngismus stridulus, 863
in measles, 153
in Raynaud's disease, 824
in typhoid fever, 226
in variola, 189
Bath-tub, Winckel's, 80
Battledore-hands in acromegaly, 691
Bednar's aphthæ, 416
Bed-sores in acute myelitis, 785
in typhoid fever, 223
with tumors of spinal cord, 803
Bed-wetting. See *Urine, incontinence of.*
in gravel, 980
Beef-tea, formula for, 25
preparation of, 226

Belladonna, administration of, in childhood, 36
in functional heart affections, 962
in incontinence of urine, 969
in intussusception, 537
in peritonitis, 583
in pertussis, 211
in typhlitis, 529
Bell's palsy, 774
Benzoic acid in alkaline lithiasis, 982
Bichloride of mercury. See *Mercuric chloride.*
for vaginal douche, 88
in typhoid fever, 226
Bigeminal pulsation, 960
Bilharzia hæmatobia a cause of hæmaturia, 965
Biliary cirrhosis, 574
Bismuth salicylate in cholera, 266
in typhoid fever, 227
subnitrate in chronic intestinal indigestion, 487
in dysentery, 509
Bladder, distention of, diagnosis of, 14
paralysis of, with tumors of spinal cord, 804
peculiarities of, in children, 1017
Blaud's pill, 380
Bleeding in cerebral meningitis, 619
Blepharitis, 1123
ciliaris. See *Blepharitis.*
etiology of, 1123
treatment of, 1123
ulcerosa, 1123
Blepharo-adenitis, 1123
Blepharospasm, 1125
tonic, 1125
treatment of, 1125
Blisters in cerebral meningitis, 620
in cerebro-spinal meningitis, 624
in diabetes insipidus, 978
Blood after paroxysm of tertian fever, 320
characteristics of, in newborn, 375
examination of, in leukæmia, 390
in lymphatic anæmia, 387
in malarial fever, 332
in pernicious anæmia, 382
in splenic anæmia, 385
in subacute purpura hæmorrhagica, 397
in cholera, 260
in diphtheria, 276, 278
infections of, in new-born, 92
in hysteria, 737
Blood-cells, colorless, in infancy, 375
Blood-cells, nucleated red, 375
Boils after vaccination, 195
with subacute milk infection, 497
Bone, analysis of, 343
cancellous tissue of, 344
compact tissue of, 344
growth of, in rachitis, 346
minute anatomy of, 344
Bones in child and adult life, 343
Borax in diphtheria, 286
Boric acid in alkaline lithiasis, 982
in gonorrhœa of mouth, 89
in vulvo-vaginitis, 1028
Bothriocephalus latus, 549
Bowels, primary tuberculosis of, 111
secondary tuberculosis of, 111
Brachial plexus, obstetric injury to, 83
Brachycardia, 960
Brachycephalic idiocy, 673
Bradycardia, 960
Brain, abscess of. See *Abscess of brain.*
following chronic suppuration of middle ear, 1117
chronic diffuse tuberculosis of, 106
in diphtheria, 277
in pernicious malaria, 324
in rachitis, 343
Bran bread in diabetes, 974
Brand method in typhoid fever, 226
Breast-milk, characters of, 21
constituents of, 21
quantity of, 21
substitutes for, 21
farinaceous, 22
deleterious effects of, 22
Breath, ammoniacal, in uræmia, 8
catarrhal, 7
"feverish," 7
fœtid, 7
gangrenous, in noma, 8
in acute gastric catarrh, 459
in chronic gastric catarrh, 463
in gangrene of lung, 894
of the child in disease, 7
in health, 7
sour, 7
Breathing, accelerated, causes of, 10
embarrassed, with tumors of spinal cord, 804
in Landry's paralysis, 799
labored, distinction of, from laryngeal obstruction, 290
Breath-sounds in croupous pneumonia, 889
Bright's disease, acute. See *Nephritis, acute tubal.*
chronic, 990
Bromides in cerebral meningitis, 620
in diabetes mellitus, 976
in epilepsy, 752
in rheumatism, 373
Bromidrosis, 1037
Bromoform in pertussis, 212
Bronchial catarrh in measles, 147
glands, chronic diffuse tuberculosis of, 106
Bronchiectasis, 899
Bronchitis, 896
acute, anatomical changes in, 898
capillary, 896. See, also, *Broncho-pneumonia.*
chronic, anatomical changes in, 899
classification of, 896
diagnosis of, 902
from pleural effusion, 903
from pneumonia, 903
etiology of, 896
in malaria, 330
in typhoid fever, 221
in variola, 187
in whooping-cough, 207
mechanical causes of, 897
mode of drinking in, 6
morbid anatomy of, 898
prognosis of, 901
sea-air in, 63
subacute, in chronic heart disease, 953
symptoms of, 899
treatment of, 903
Broncho-adenitis, diagnosis of, from tuberculosis, 901
in etiology of asthma, 927
of bronchitis, 898
treatment of, 903
Bronchophony in pleural effusion, 914
Broncho-pneumonia, 876
acute tuberculous, 116
morbid anatomy of, 117
pneumococci in, 117
staphylococci in, 117
streptococci in, 117
symptoms of, 118
diagnosis of, 881
from croupous pneumonia, 881
from pleurisy with effusion, 881
duration of, 881
etiology of, 876
in etiology of fibroid phthisis, 935
of secondary pleurisy, 909
in scarlatinal nephritis, 166
in variola, 187
in whooping-cough, 207
morbid anatomy of, 877
physical signs of, 880

Broncho-pneumonia, prognosis of, 881
symptoms of, 878
treatment of, 882
Bronchus, compression of, by cheesy glands, 109
Bruit of fontanelle, 355
Buelau operation. See *Siphonage.*
Buhl's disease, 92
Bullous syphiloderm, 1088
Burn of eyelid, 1128
Burns of conjunctiva, 1136
Burrow of itch-mite, 1098
Butyric acid, presence of, in acute gastric catarrh, 459

C.

Cachexia of malaria, 329
Cæcitis, 525
Cæcum and appendix, inflammatory affections of, 525
diagnosis of, 527
from enteritis, 527
from hip disease, 528
from iliac abscess, 527
from internal strangulation, 527
from intussusception, 527
from psoas abscess, 527
etiology of, 526
exciting causes of, 526
morbid anatomy of, 525
prognosis of, 528
after perforation, 528
symptoms of, 526
treatment of, 529
Caffeine in migraine, 720
Calamine-and-zinc lotion, 1039
in eczema of ears, 1053
of face, 1053
Calcification of fangs of teeth, 426
of tubercle, 102
Calcium-carbonate calculus, 1010
Calcium-phosphate calculus, 1010
Calcium sulphide in furunculus, 1068
Calculi, impacted, in ureters, 979
mode of formation of, 979
Calculus, vesical, 1010
classification of, 1010
diagnosis of, 1015
etiology of, 1011
examination for, in females, 1016
in children, varieties of, 1010
Calculus, vesical, operative treatment of, 1018
in females, 1024
relative frequency of, 1012
solvent treatment of, 1016
symptoms of, 1014
treatment of, 1016
Callus, spurious, 85
Calomel in acute gastric catarrh, 461
in acute milk infection, 494
in constipation, 516
in pleurisy, 918
in typhlitis, 529
sublimed, in diphtheria, 287
vapor in diphtheria, 282
Camphor in diphtheria, 283
Canaliculi of bone, 344
Cancer of omentum, 586
Cancrum oris. See *Stomatitis gangrenosa.*
Cane-sugar, 46
Cannabis indica in pertussis, 211
Cantharides as a cause of hæmaturia, 964
Caput Medusæ, 588
succedaneum, 68
abscess in, 69
mechanism of, 68
pathology of, 69
treatment of, 69
Carbohydrates in breast-milk, 21
in subacute milk infection, 499
Carbolic acid as a cause of hæmaturia, 964
in diphtheria, 287
in eczema, 1050
in ophthalmia neonatorum, 1131
in whooping-cough, 212
Carbolic-acid injections in treating erysipelas, 251
Carcinoma, encephaloid, of kidney, 1007
of peritoneum, 586
Carcinomata of brain, 638
Cardiac impulse, extended, significance of, 15
neuroses, 958
Caries of orbit, 1144
of wall of auditory canal, 1109
Carpopedal spasms in laryngismus stridulus, 861
Caseation in tubercle, 102
Casein in breast-milk, 21, 46
in cow's milk, 21, 46
in human milk, 21, 46
Casselberry's forceps, 449
staphylorraphy-needle, 452
tonsillotome, 440
Castor oil in acute intestinal indigestion, 482
in constipation, 515
Casts in acute tubal nephritis, 984
Casts in chronic interstitial nephritis, 998
in first stage of chronic tubal nephritis, 991
in second stage of chronic tubal nephritis, 991
in third stage of chronic tubal nephritis, 991
Catalepsy, 732
Cataract, congenital, 1145
complete, 1145
treatment of, 1145
partial, treatment of, 1145
Catarrh, acute gastric. See *Gastric catarrh, acute.*
bronchial, in measles, 147
gastro-intestinal, in cirrhosis of liver, 574
intestinal, in measles, 147
nasal, sea-air in, 63
objections to use of the term, 458
pharyngeal, sea-air in, 63
Catarrhal headache, 722
nephritis, acute. See *Nephritis, acute tubal.*
chronic. See *Nephritis, chronic tubal.*
pneumonia. See *Broncho-pneumonia.*
in stomatitis gangrenosa, 422
symptoms of measles, 144
Catarrhs in rachitis, 341, 357
of larynx and bronchi in etiology of laryngismus stridulus, 859
Cathartics in acute myelitis, 786
in chronic tubal nephritis, 995
Cautery in hæmorrhage after tonsillotomy, 442
Cautions in syringing in auditory canal, 1108
Cavernous tumors of skin, 1081
Cellulitis in typhoid fever, 223
of neck in scarlet fever, 164
suppuration or gangrene in, 164
of orbit, 1144
Central cataract. See *Cataract, congenital.*
Cephalalgia. See *Headache.*
Cephalhæmatoma, 69
bony ring in, 70
diagnosis of, 70
from aneurism, 72
from encephalocele, 72
from hernia cerebri, 72
from tumors due to violence, 72
etiology of, 71
false, 69
intracranial, 70
in utero, 71
multiple, 71
pathology of, 70

Cephalhæmatoma, treatment of, 72
true, 69
Cephalic index, 673
Cerebral complications in pertussis, 208
lesions following scarlatinal nephritis, 167
pneumonia, 888
symptoms in pleurisy, 913
in rheumatism, 368
Cerebro-spinal meningitis, epidemic, 230
bacteriology of, 230
complications of, 233
definition of, 230
diagnosis of, 234
from scarlatina, 234
from tubercular meningitis, 234
from typhoid fever, 234
etiology of, 230
history of, 230
pathology of, 231
prognosis of, 234
prophylaxis of, 234
relation of, to influenza, 231
sequelæ of, 233
symptoms of, 231
synonyms of, 230
treatment of, 234
simple. See *Meningitis, simple cerebro-spinal.*
Certified milk, 39
Cerumen impaction, 1106
treatment of, 1106
Cervical glands, enlargement of, in rubella, 177
Chalazion, 1124
treatment of, 1124
Chalybeate tonics after acute tubal nephritis, 989
in chronic interstitial nephritis, 998
in chronic tubal nephritis, 994
Champagne in peritonitis, 582
Chancre of eyelids, 1124
Chemistry of artificial foods, 47
Chemosis of conjunctiva, 1135
Chenopodium against ascarides, 545
against seat-worms, 547
Chest, auscultation of, in infants and children, 15
characteristics of, in emphysema, 15
in infants, 15
in pleural effusion, 15
in rickets, 15
contraction of, in fibroid phthisis, 936
examination of, 14
in disease, 15
posture for, 14
inspection of, 15
palpation of, 16
Chest, percussion of, 16
retraction of, 15
Chest-wall, retraction of, after pleurisy, 917
Cheyne-Stokes respiration, 10
in cerebro-spinal meningitis, 232
Chicken-pox, 179
course of, 181
diagnosis of, 181
from variola, 181
eruption of, 179
history of, 179
incubation of, 179
prognosis of, 181
quarantine of, 182
sequelæ of, 181
symptoms of, 179
treatment of, 181
vesicles of, 180
Chilblain, 1040
Child, anatomical peculiarities in, 512
Child-crowing, 744
Childhood, diet in, 32
diet-tables for, 32
duration of, 1
Children, general management of, 18
Chill. See *Chilliness* and *Chills.*
in acute spinal leptomeningitis, 779
in acute tubal nephritis, 983
in croupous pneumonia, 886
in epidemic cerebro-spinal meningitis, 230
in erysipelas, 247
in pleurisy, 912
in typhlitis, 526
Chilliness in chicken-pox, 179
in measles, 143
in rubella, 176
in scarlet fever, 160
in small-pox, 184
Chills in cerebro-spinal meningitis, 231
in influenza, 238
in peritonitis, 581
in pyonephrosis, 1004
in simple cerebral meningitis, 614
in variola, 184
Chloral in asthma, 932
in broncho-pneumonia, 884
in chorea, 763
in eclampsia, 745
in pertussis, 211
in rheumatism, 373
in scarlet fever, 169
in variola, 188
Chloride of iron in acute follicuous tonsillitis, 436
in diphtheria, 284
in erysipelas, 250
in scarlet fever, 169
in variola, 189
Chlorodyne in cholera, 266
Chloroform in cerebral meningitis, 620
Chloroform in eclampsia, 745
in paroxysm of asthma, 932
in tracheotomy, 298
in uræmic convulsions, 988
Chlorosis, 378
diagnosis of, 379
from pernicious anæmia, 380
etiology of, 378
morbid anatomy of, 379
prognosis of, 380
symptoms of, 378
treatment of, 380
Choked disk in brain abscess, 634
in cerebral meningitis, 617
Cholera Asiatica, 253
conditions of infection in, 257
definition of, 253
diagnosis of, 264
etiology of, 253
fondroyant attacks of, 263
modes of infection in, 256
non-contagious attacks of, 258
personal hygiene during epidemics of, 271
prognosis of, 265
prophylaxis of, 270
secondary septic fever in, 263
special complications of, 264
special phases of, 263
symptoms of, 258
in algid stage, 262
in period of reaction, 262
in period of serous evacuations, 259
in prodromal period, 259
treatment of, 265
in algid stage, 270
in period of reaction, 270
in prodromal period, 266
in stage of serous diarrhœa, 267
infantum. See *Milk infection, acute.*
infectiosa epidemica. See *Cholera Asiatica.*
sicca, 264
Choleriform diarrhœa, 491. See *Milk infection, acute.*
Chorea, 754
after influenza, 239
description of, 754
diagnosis of, 760
from habit spasm, 761
from *maladie des tics convulsifs*, 760
from paramyoclonus multiplex, 761
from post-hemiplegic hemichorea, 761

Chorea due to ascarides, 543
duration of, 755
etiology of, 756
in etiology of incontinence of urine, 969
in hereditary syphilis, 649
major, 732
minor, 754
pathology of, 759
prognosis of, 762
relation of, to endocarditis, 758
to rheumatism, 756
treatment of, 762
with rheumatism, 369
Choreic idiocy, 675
insanity, treatment of, 709
Choreiform movements in infantile cerebral palsies, 654
Chronic catarrh after diphtheria, treatment of, 288
Chrysarobin in favus, 1094
in psoriasis, 1057
in tinea tonsurans, 1097
Chyluria, 967
in elephantiasis, 967
Circumcision, 1031
tuberculosis after, 98
Cirrhosis of liver, 574
hypertrophic, 574
in diabetes mellitus, 971
in the etiology of ascites, 587
of lung. See *Phthisis, fibroid.*
Claustrophobia, 704
Clavicle, changes in, in rachitis, 351
fracture of, at birth, 85
Clavus, 730
Cleft palate, 450
etiology and pathology of, 450
operative treatment of, 451
palliative treatment of, 451
prophylaxis of, 451
symptoms of, 450
Clemens's solution, 976
Climate, change of, in asthma, 934
in whooping-cough, 210
in etiology of vesical calculus, 1012
Clinical investigation of disease, 1
inspecting the child in, 3
physical examination in, 9
questioning the attendants in, 2
Clothing, 34
in chronic heart disease, 956
Clubbing of fingers and toes in fibroid phthisis, 937
Coagulable lymph in peritonitis, 580
Coal-oil in pediculosis, 1100
Cocaine in pertussis, 212
Coccus of vaccinia, 193
Cocoanut against tænia, 553
Codeine in acute tubal nephritis, 987
in diabetes mellitus, 976
in phthisis, 126
Cod-liver oil in broncho-adenitis, 906
in convalescence from variola, 190
in convalescence of mucous disease, 478
in lupus vulgaris, 1084
in pulmonary emphysema, 926
in rachitis, 363
in simple atrophy, 523
in splenic anæmia, 386
in syphilis, 140
in tuberculosis, 125
Cœliotomy in chronic peritonitis, 586
in tumors of peritoneum, 587
Cohen's tracheotomy-tube, 296
Cold applications in peritonitis, 583
douches in incontinence of urine, 969
in acute spinal leptomeningitis, 781
in cerebral meningitis, 620
in epidemic cerebro-spinal meningitis, 235
in erysipelas, 251
in etiology of acute peritonitis, 579
of chronic tubal nephritis, 990
of croupous pneumonia, 885
of pleurisy, 910
in ophthalmia neonatorum, 1130
in peritonsillar abscess, 437
in Raynaud's disease, 825
in tubercular meningitis, 630
in variola, 189
sore. See *Herpes simplex.*
Colic intussusception, 533
Collapse of lung following broncho-pneumonia, 880
Colles's law, 128
Collyria in simple conjunctivitis, 1129
Color-fields, narrowing of, in hysteria, 734
Colostrum, 18
Coma in cerebro-spinal meningitis, 231
in malignant measles, 147
in pernicious malaria, 330
in scarlet fever, 161
uræmic, 983
Comedo, 1036
treatment of, 1036
Comma bacillus, 253. See *Spirillum choleræ Asiaticæ.*
Compensation, failure of, in chronic heart disease, 953
in heart-disease, 953
Compensatory emphysema. See *Emphysema, compensatory.*
Concepts, 703
Condensed milk, 49
analysis of, 49
disadvantages of, 22
food value of, 49
for temporary use, 22
in etiology of scorbutus, 405
Condiments in diabetic diet, 975
Condylomata, treatment of, 1091
Congenital affections of heart, 940
iritis, 1142
malformations, 84
Conium in clonic blepharospasm, 1125
Conjunctiva, atrophy of, 1136
diseases of, 1128
ecchymosis of, 1135
in jaundice, 559
injuries of, 1136
pemphigus of, 1136
tubercle of, 1136
tumors and cysts of, 1136
xerosis of, 1140
Conjunctival congestion in rubella, 177
Conjunctivitis. See *Conjunctivitis, simple.*
chronic granular, types of, 1134
diphtheritic, 1132
symptoms of, 1132
treatment of, 1132
follicular, 1133
treatment of, 1133
granular, 1134
sequelæ of, 1134
symptoms of, 1134
treatment of, 1135
in measles, 144
in variola, 187
muco-purulent. See *Conjunctivitis, simple.*
purulent, 1129. See, also, *Ophthalmia neonatorum.*
etiology of, 1129
non-specific variety of, 1129
simple, 1128
etiology of, 1128
prognosis of, 1129
symptoms of, 1129
treatment of, 1129
spring, 1133
symptoms of, 1133

Conjunctivitis, spring, treatment of, 1133
Constipation, chronic, 512
diagnosis of, 514
etiology of, 512
extrinsic causes of, 513
intrinsic causes of, 512
pathology of, 513
prognosis of, 515
symptoms of, 514
treatment of, 515
habitual, in etiology of typhlitis, 526
in chronic gastric catarrh, 464
in diabetes mellitus, 972
in diseases of nervous system, 513
in infants, 513
in intussusception, 535
in invasion of variola, 184
in measles, 144
in typhlitis, 527
in typhoid fever, 220
Contracted kidney. See *Nephritis, chronic interstitial.*
Contractures in acute spinal leptomeningitis, 780
in hysteria, 734
with tumors of spinal cord, 803
Conus arteriosus, stenosis of, 943
Convalescence from chicken-pox, 182
from scarlet fever, 167
from variola, 190
Convallaria in chronic heart disease, 957
Convulsions. See *Eclampsia.*
due to ascarides, 543
in acute gastric catarrh, 460
in acute myelitis, 784
in acute spinal leptomeningitis, 779
in brain abscess, 634
in brain tumors, 639
in cerebro-spinal meningitis, 231
in chicken-pox, 179
in croupous pneumonia, 886
in erysipelas, 247
in hereditary syphilis, 647
in infantile cerebral palsies, 653
in invasion of variola, 184
in jaundice due to obliteration of bile-ducts, 562
in malignant measles, 147
in measles, 148
in onset of pleurisy, 912
in pernicious malaria, 330
in scarlet fever, 161
in simple cerebral meningitis, 614
in teething, 428
in tubercular meningitis, 628
in whooping-cough, 208
Convulsions replacing chill in malarial fever, 327
Cooled bath in diphtheria, 284
Copper sulphate in trachoma, 1135
Coprolalia, 663
Cord, spinal, in rachitis, 343
umbilical, prolapse of, 77
treatment of, 77
treatment of, after birth, 86
Cornea, affections of, in simple cerebro-spinal meningitis, 622
danger to, in ophthalmia neonatorum, 1130
diseases of, 1138
foreign bodies in, 1141
injuries of, 1141
ulcer of. See *Ulcer of cornea.*
ulceration of, in variola, 187
Corneal ulceration, results of, 1139
ulcers in ophthalmia neonatorum, 1130
Corrosive sublimate. See *Mercuric chloride.*
for nævus vascularis, 1083
Coryza in hereditary syphilis, 133
in rubella, 177
replacing sweating in malaria, 330
Cosme's paste in lupus vulgaris, 1085
Coster's paint in tinea tonsurans, 1097
Cotton jacket in bronchitis, 904
in broncho-pneumonia, 882
in croupous pneumonia, 890
Cough, character of, in bronchitis, 6
in laryngeal catarrh, 6
in pneumonia and pleurisy, 7
in spasmodic croup, 6
in true croup, 6
in bronchitis, 900
in broncho-pneumonia, 879
in croupous pneumonia, 887
in disease, 6
in measles, 144, 146
in pleurisy, 912
in severe spasmodic laryngitis, 852
in simple catarrhal laryngitis, 846
in spasmodic laryngitis, 848
in whooping-cough, 206
region in whooping-cough, 204
with broncho-adenitis, 901
Counter-irritation in acute myelitis, 786
in bronchitis, 904
Counter-irritation in cirrhosis of liver, 575
Cowling's rule, 35
Cow-pox. See *Vaccinia.*
spontaneous, 191
Cow's milk, 21
characters of, 21
constituents of, 21
definition of, 38
effect of dilution of, 23
Cracked-pot sound in pulmonary tuberculosis, 120
Cramps in cholera, 260
Craniectomy in hydrocephalus, 631
in idiocy, 681
Craniotabes in rachitis, 348
relation of, to laryngismus stridulus, 356
symptoms of, 355
syphilitic, 132
Cream, importance of, in diet, 361
Creasote in broncho-adenitis, 906
in diabetes mellitus, 977
in gangrene of lung, 895
in jaundice, 565
intrapulmonary injection of, 125
in tuberculosis, 125
Crédé's method, 1132
Creolin for vaginal douche, 88
in erysipelas, 251
in hæmorrhages from mucous surfaces, 82
in mucous disease, 476
Crescentic bodies in æstivo-autumnal fever, 324
Cretinism, 685
diagnosis of, 685
etiology of, 685
pathology of, 685
prognosis of, 686
symptoms of, 682
synonyms of, 682
treatment of, 686
Crisis in croupous pneumonia, 888
Critical period in chronic heart disease, 955
Cross-legged progression in infantile cerebral palsies, 654
Croton oil in tinea tonsurans, 1098
Croup, catarrhal. See *Laryngitis, spasmodic, severe.*
spasmodic. See *Laryngitis, catarrhal.*
Croupous nephritis, acute. See *Nephritis, acute tubal.*
chronic. See *Nephritis, chronic tubal.*
pneumonia. See *Pneumonia, croupous.*
in etiology of secondary pleurisy, 909

Crust-formation in atrophic rhinitis, 834
Cry, causes of the, 6
character of, in spasmodic croup, 6
hydrencephalic, description of, 6
in acute pleuritis, 6
in disease, 6
in epilepsy, 749
in intestinal pain, 6
in membranous croup, 6
in simple catarrhal laryngitis, 846
nasal tone of, in swelling of nasal mucous membrane, 6
Crying during cough, indication of, 6
Curative effects of erysipelas, 252
Curetting in lupus vulgaris, 1086
Curschmann's spirals in asthma, 929
Curvature, lateral, 54
Curvatures of spinal column, rachitic, 349
Cyanosis in acute endocarditis, 950
in broncho-pneumonia, 879
in chronic heart disease, 953
in pulmonary tuberculosis, 120
of face in lymphatic anæmia, 387
Cyclitis, 1143
Cyst of brain, 638
of omentum, 586
of orbit, 1145
paranephric, 1000
renal, 999
Cysticerci in children, 551
Cysticercus cysts, 550
Cystic-oxide calculus, 1010

D.

Dacryoadenitis, 1143
Dacryocystitis, 1143
Dactylitis in late hereditary syphilis, 138
syphilitic, 131
diagnosis of, from tubercular, 137
symptoms of, 135
Dairies, care of milk in, 39
hygienic conditions of, 38
inspection of, 38
Dance's sign in intussusception, 536
Davies-Colley method of staphylorraphy, 455
"Dead finger," 821
Deaf-mutes, education of, 1120
Deaf-mutism, 664
Deafness, acquired labyrinthine, 1120
after parotitis, 200
Deafness in hysteria, 733
Death after tracheotomy, causes of, 304
Death-rate at the sea-coast, 61
Deaver's retractor, 870
Debility in chronic tubal nephritis, 991
Decubitus in disease, 4
in diseases of liver, 556
in pericarditis, 947
in peritonitis, 581
in simple cerebro-spinal meningitis, 622
in suppurative hepatitis, 570
in typhlitis, 526
Deep cervical fascia, 292
Defect of ventricular septum, 941
Deficiency of phosphates in etiology of cleft palate, 450
Deformities in mouth and pharynx, 666
of trunk and limbs in idiocy, 677
spinal, 54
Degeneration, acute fatty, of new-born, 92
Delay in walking, causes of, 13
Delirium cordis, 960
in cerebro-spinal meningitis, 231
in chicken-pox, 179
in invasion of variola, 184
in rheumatism, 368
in scarlet fever, 160
in simple cerebral meningitis, 614
in simple cerebro-spinal meningitis, 623
in typhoid fever, 222
period of, in hysteria, 731
Dental sac, 426
Dentine-germ, 426
Dentition, 425. See, also, *Teething.*
delayed, phosphorus in, 427
relation of, to rachitis, 337
effect of rachitis upon, 354
in etiology of eclampsia, 743
of laryngismus stridulus, 859
primary, frequency of broncho-pneumonia during, 876
retarded by chronic diarrhœa, 427
by rickets and syphilis, 427
Depletion in cirrhosis of liver, 575
Depurative disease. See *Amyloid disease of kidney.*
Dermatitis exfoliativa neonatorum, 1063
gangrenosa infantum, 1064
treatment of, 1065
in rachitis, 357
Dermoid cyst of eyelid, 1127
cysts behind auricle, 1104
Desquamation in measles, 145
in rubella, 177
in scarlet fever, 162
Desquamative nephritis, acute. See *Nephritis, acute tubal.*
Development, general, 12
in health, 12
of new-born child, 12
of articulation, 665
of senses, 665
Dextrin, 45, 50
Dextrinized attenuants, 50
analysis of, 50
Dextrose, 45
Diabetes insipidus, 977
diagnosis of, 977
etiology of, 977
morbid anatomy of, 977
prognosis of, 977
symptoms of, 977
treatment of, 978
mellitus, 971
diagnosis of, 972
etiology of, 971
hygienic treatment of, 975
in etiology of chronic tubal nephritis, 991
of incontinence of urine, 970
morbid anatomy of, 971
prognosis of, 973
symptoms of, 971
treatment of, 974
Diacetic acid in diabetic urine, 972
Diaphoresis in acute tubal nephritis, 985
in chronic tubal nephritis, 995
in scarlatinal nephritis, 171
Diarrhœa, catarrhal, 497
chronic. See *Indigestion, chronic intestinal.*
croupous, 497
during teething, 428
treatment of, 429
dysenteric, 497
formula for, in typhoid fever, 228
in broncho-pneumonia, 879
in chronic peritonitis, 584
in invasion of variola, 184
in leukæmia, 390
in malarial fever, 330
in measles, 144, 146
in prodromal period of cholera, 259
in pulmonary tuberculosis, 120
in scarlet fever, 160, 164
in simple atrophy, 521
in tuberculosis, 110
in typhoid fever, 218
simple. See *Indigestion, acute intestinal.*
with constipation, 514

Diarrhœal diseases, 479
classification of, 479
Diathesis, scrofulous, 100
tuberculous, 100
characteristics of, 15
Diet in acute gastric catarrh, 462
in acute tubal nephritis, 989
in asthma, 933
in broncho-pneumonia, 882
in chronic gastric catarrh, 466
in chronic intestinal indigestion, 486
in chronic peritonitis, 585
in chronic tubal nephritis, 994
in cirrhosis of liver, 575
in croupous pneumonia, 890
in diabetes mellitus, 974
in diphtheria, 283
in dysentery, 508
in eczema, 1048
in erysipelas, 251
in etiology of secondary anæmia, 376
of vesical calculus, 1012
in functional affections of heart, 961
in gonorrhœa, 1026
in influenza, 241
in jaundice, 563
in laryngismus stridulus, 864
in lithiasis, 982
in measles, 151
in peritonitis, 582
in prophylaxis of stone, 1016
in pulmonary emphysema, 926
in rachitis, 360
in rheumatism, 372
in scarlet fever, 169
in simple atrophy, 523
in typhlitis, 529
in typhoid fever, 225
in whooping-cough, 210
of infant in health, 29
tables of, 29, 30
water in, 30
Diffuse nephritis, chronic. See *Nephritis, chronic tubal.*
trachoma, 1134
Digestion of cow's milk, 46
Digitalis in acute endocarditis, 952
in acute tubal nephritis, 989
in croupous pneumonia, 890
in chronic heart disease, 956
in chronic tubal nephritis, 995
in diphtheria, 283
in functional heart affections, 961
in malignant measles, 152
in pericarditis, 948
in peritonitis, 583
in pleurisy, 918
Digitalis in scarlatinal nephritis, 172
in typhoid fever, 229
Dilatation in treatment of adherent prepuce, 1030
of heart in scarlatinal nephritis, 167
Diphtheria, 272
antitoxines of, 288
ascending, of trachea and larynx, 280
bacteriology of, 274
complicated by parotitis, 198
complicating other diseases, 281
definition of, 272
diagnosis of, from catarrhal and spasmodic laryngitis, 279
from other pseudo-membranes, 277
from simple follicular amygdalitis, 278
disinfection in, 282
etiology of, 272
general disease theory of, 273
incubation of, 275
in etiology of chronic tubal nephritis, 991
in typhoid fever, 220
local pathological changes in, 276
local treatment of, 285
mode of infection and propagation of, 275
mortality of, 282
nasal, in scarlet fever, 168
of anus, 604
of bronchi, 281
of conjunctiva, 280
of larynx, 279
of nares, 279
of pharynx and mouth, 279
of tonsils, 278
prognosis of, 281
prophylaxis of, 282
sequelæ of, 281
symptoms and diagnosis of, 277
synopsis of treatment of, 289
treatment of, 283
of albuminuria of, 288
of anæmia following, 288
unfavorable prognostic signs in, 282
with pertussis, 208
Diphtheritic sore throat. 434
Diplococcus in normal urethra, 1026
pneumoniæ. See *Pneumococcus.*
in pleurisy, 910
scarlatinæ sanguinis, 158
Diplopia, monocular, in hysteria, 734
Dipsomania, 703
Discharge in chronic suppuration of middle ear, 1115
Discharge in ophthalmia neonatorum, 1130
Disease, appearance of the skin in, 5
Buhl's, 92
clinical investigation of, 1
cough in, 6
cry in, 6
decubitus in, 4
expression of the face in, 3
fæcal evacuations in, 8
features of, 3
mode of drinking in, 6
temperature in, 12
urine in, 8
Winckel's, 92
Disinfection after purpura hæmorrhagica, 400
against seat-worms, 548
during pertussis, 210
in acute milk infection, 495
in cholera, 270
in influenza, 241
in malignant measles, 154
in scarlet fever, 173
in variola, 190
of intubation-tubes, 317
of skin in variola, 189
of typhoid dejections, 225
Dislocations at birth, treatment of, 85
in utero, causes of, 84
Displacement of viscera in pleurisy, 914
Disseminated sclerosis in hereditary syphilis, 649
Dissociation symptom of syringomyelia, 812
Distichiasis, treatment of, 1126
Diuretic pill, compound, 957
Diuretics in chronic tubal nephritis, 995
Diuretin in scarlatinal nephritis, 172
Dolichocephalic idiocy, 673
Douche in atrophic rhinitis, 836
Dover's powder in phthisis, 126
in pleurisy, 918
Drainage, permanent, in ascites, 590
Drinking, mode of, in disease, 6
in disease of throat, 6
in pneumonia, 6
in severe bronchitis, 6
in soreness of mouth, 6
Drinking-water in etiology of amœbic dysentery, 506
of dysentery, 502
Drinks in diabetic diet, 975
Drop-foot in acute poliomyelitis, 793
Dropsy. See *Œdema.*
in acute tubal nephritis, 984
in chronic tubal nephritis, 991
Drowsiness in jaundice, 559
in measles, 144

Drugs in etiology of acute tubal nephritis, 983
Drum-head. See *Drum-membrane.*
Drum-membrane, distention of, 1111
in childhood, misapprehensions concerning, 1110
incision of, 1112
retraction of, in chronic tympanic catarrh, 1119
Dry cases of tracheotomy, 302
catarrh, 833
cups in epidemic cerebro-spinal meningitis, 235
pleurisy, 907
Dryness of tissues in diabetes mellitus, 972
Ductus arteriosus, persistence of, 943
diagnosis of, 944
Duke's method of artificial respiration, 79
Dulness, area of, in pericardial effusion, 947
movable, in pleural effusion, value of, in children, 915
of liver, superior border of, 16
Dysæsthesia in Landry's paralysis, 799
Dysentery, 501
amœbic, 506
diagnosis of, 507
lesions of liver in, 506
morbid anatomy of, 506
prognosis of, 507
symptoms of, 507
catarrhal, 501
absence of specific germ in, 502
diagnosis of, 505
etiology of, 501
improper feeding in etiology of, 502
microscopic appearances in, 503
prognosis of, 505
symptoms of, 504
diphtheritic, 507
microscopical appearances in, 507
disinfection in, 508
hygiene of, 508
in scarlet fever, 164
morbid anatomy of, 502
prophylaxis of, 508
treatment of, 508
varieties of, 501
Dyslexia, 661
Dyspepsia, acute. See *Gastric catarrh, acute.*
Dysphagia in Landry's paralysis, 799
Dysphrasia, 661
Dyspnœa, expiratory, 10
causes of, 10
in aortic stenosis, 954
Dyspnœa in asthma, 930
in bronchitis, 901
in broncho-pneumonia, 878
in chronic heart-disease, 953
in fibroid phthisis, 937
in leukæmia, 390
in lymphatic anæmia, 387
in marked laryngeal stenosis, 10
in mitral stenosis, 954
in pericarditis, 947
in pleurisy, 913
in progressive pernicious anæmia, 381
in pulmonary tuberculosis, 120
in secondary anæmia, 377
in spasmodic laryngitis, 849
inspiratory, causes of, 10
in substantive emphysema, 925
Dystochia from hydronephrosis, 1001

E.

Ear, anatomy of, 1111
diseases of, 1102
importance of, 1102
embryology of, 1102
external, affections of, 1103
internal, affections of, 1119
middle, acute simple inflammation of, 1110
affections of, 1110
chronic catarrh of, 1118
chronic suppuration of, 1114
treatment of eczema of, 1053
treatment of, method of holding child in, 1103
Earache, a symptom, 1110
Eberth's bacillus, 215
Ecchymosis in cholera, 261
of conjunctiva, 1135
of eyelids, 1128
treatment of, 1128
Echinococcus cyst of brain, 638
Echolalia, 663
Eclampsia, 741
diagnosis of, 745
etiology of, 742
in chronic constipation, 514
in prognosis of scarlatina, 168
in rachitis, 357
pathology of, 743
prognosis of, 744
seat of origin of, 741
symptoms of, 744
treatment of, 745
Ectopia cordis, 945
Ectropion, 1127
Eczema, 1044
after vaccination, 195
associated with asthma, 929
diagnosis of, 1047
Eczema, diagnosis of, from papular urticaria, 1047
from pediculosis capillitii, 1048
from scabies, 1047
from syphilodermata, 1047
etiology of, 1046
intertrigo, 1046
treatment of, 1054
marginal, of lids, 1123
of ears, treatment of, 1053
of face, treatment of, 1053
of lids, treatment of, 1054
of scalp, treatment of, 1053
prognosis of, 1053
resemblance of, to mucous catarrhs, 1045
rubrum or madidans, 1045
seborrhœal, 1035
squamosum, 1045
treatment of, 1048
of regional forms of, 1053
Eczematous inflammations of auricle, 1104
Education in moral imbecility, 681
Educational treatment of idiocy, 680
Effleurage, 57
Effusion, pleural, diagnosis of, 915
diagnostic use of hypodermic needle in, 915
Eggs in diabetic diet, 975
Egg-water, preparation of, 226
Ehrlich's reaction in acute tuberculosis, 105
test, in children, 221
Eichoff's thymol soap, 1049
Elaterium in chronic tubal nephritis, 995
Electric cataphoresis in tinea tonsurans, 1098
Electrical excitability in tetany, 765
Electricity in acute poliomyelitis, 794
in incontinence of urine, 969
in infantile cerebral palsies, 659
in nævus vascularis, 1082
Electrization of stomach in mucous disease, 477
Electro-cautery in hypertrophic rhinitis, 833
Electrolysis in treatment of lupus vulgaris, 1086
of molluscum epitheliale, 1074
of nævus pigmentosus, 1076
of verruca, 1075
Elongation of uvula, 433
Emaciation, rapid, in diabetes mellitus, 972
Embolism in acute endocarditis, 950
in infantile cerebral palsies, 658

Embolism of brain in rheumatism, 369
Embryocardia, 960
Embryonine, 974
Emetics in broncho-pneumonia, 883
in eclampsia, 745
Emotions in etiology of hysteria, 729
Emphysema, compensatory, 922
etiology of, 922
pathology of, 923
symptoms of, 923
treatment of, 925
in pertussis, 208
interstitial, 922
of eyelids, 1128
pulmonary, 922
subpleural, complicating broncho-pneumonia, 880
substantive, 923
etiology of, 923
pathology of, 924
physical signs of, 925
prognosis of, 925
symptoms of, 925
treatment of, 925
surgical, after tracheotomy, 306
vesicular or alveolar, 922
Emprosthotonos in cerebro-spinal meningitis, 232
Empyema, 907
in etiology of pericarditis, 947
in pertussis, 207
in scarlatinal nephritis, 166
necessitatis, 918
of antrum in etiology of nasal myxomata, 841
perforation of, 917
Enamel-germ, 426
Endocardial murmurs in rheumatism, 368
Endocarditis, acute, 949
etiology of, 949
physical signs of, 950
prognosis of, 951
symptoms of, 950
treatment of, 952
with old valvular lesions, 951
during scleroderma, 1077
in diphtheria, 278
in rheumatism, 368
in scarlatinal nephritis, 167
in variola, 187
relation of, to chorea, 950
ulcerative, 369
Enemata against seat-worms, 548
in chronic intestinal indigestion, 487
in constipation, 515
in prolapse of rectum, 607
in typhoid fever, 228
nutritive, in peritonitis, 285
Enlargement of liver, diagnosis of, 556
Enterectomy in intussusception, 539
Enteroclysis in cholera, 268
Entero-colitis. See, also, *Milk infection, subacute.*
anatomical changes of, 496
chronic, 483. See *Indigestion, chronic intestinal.*
in measles, 147
in variola, 187
sea-air in treatment of, 62
Enterorraphy, circular, in congenital malformations of intestines, 592
in intussusception, 539
Enterotomy in intussusception, 538
Entropion, 1126
treatment of, 1127
Enucleation in sympathetic irritation, 1143
Eosinophile cells, value of, in diagnosis, 392
Epilation in tinea favosa, 1094
in tinea tonsurans, 1097
Épilepsie larvée, 750
Epilepsy, 747
as a cause of incontinence of urine, 970
diagnosis of, 751
from gross brain disease, 751
from hysteria, 751
from uræmia, 751
etiology of, 748
in hereditary syphilis, 647
in infantile cerebral palsies, 655
morbid anatomy of, 748
motor symptoms of, 749
pathology of, 748
prognosis of, 752
symptoms of, 749
psychic, 750
sensory, 749
treatment of, 752
varieties of, 751
Epileptic headache, 722
insanity, treatment of, 710
Epileptogenetic centres, 742
Epileptoid period of hysteria, 730
Epiphora in diseases of lachrymal sac, 1143
Epiphyseal swelling in syphilis, diagnosis of, from rickets, 131
Epiphyseo-diaphyseal separation in hereditary syphilis, 131
Epistaxis in chronic heart disease, 953
in hæmophilia, 393
in measles, 148
in typhoid fever, 218, 221
Epithelioid cells, 102
Epstein's apparatus for bowel-washing, 476
Ergot in cerebro-spinal meningitis, 624
in diabetes insipidus, 978
in diabetes mellitus, 976
in epidemic cerebro-spinal meningitis, 235
in incontinence of urine, 970
in Landry's paralysis, 800
Ergotine in gastro-intestinal hæmorrhage, 87
in scarlatinal nephritis, 172
Erotomania, 703
Eruption of cerebro-spinal meningitis, 233
of chicken-pox, 179
of erysipelas, 248
of rubella, 177
of scarlet fever, 161
of typhoid fever, 220
of variola, 185
stage of desiccation of, 185
stage of maturation of, 185
upon mucous membranes, 185
Eruptions, exanthematous, on eyelids, 1123
in cholera, 264
in diphtheria, 281
in measles, 144
in rheumatism, 370
Erysipelas, 243
after tracheotomy, 305
after vaccination, 195
complications and sequelæ of, 248
contagiousness of, 245, 250
definition of, 243
diagnosis of, 249
from acne rosacea, 249
from angeio-neurotic œdema, 249
from erythema, 249
from malignant œdema, 249
from urticaria, 249
etiology of, 243
history of, 243
of auricle, 1104
of new-born, 90, 247
pathological anatomy of, 245
prognosis of, 249
pulmonary lesions in, 246
symptoms of, 247
therapeutic use of, 251
treatment of, 250
with peritonitis, 580
Erythema annulare, 1042
bullosum, 1042
caloricum, 1040
gyratum, 1042
idiopathic, 1039
infantile, 1041
diagnosis of, from measles, 1042
from rötheln, 1042
from scarlatina, 1042

Erythema infantile, treatment of, 1042
in rheumatism, 370
intertrigo, 1040
diagnosis of, 1040
treatment of, 1040
in vaccination, 195
iris, 1042
marginatum, 1042
multiforme, 1042
diagnosis of, 1043
etiology of, 1043
prognosis of, 1043
treatment of, 1043
nodosum, 1043
of buttocks in subacute milk infection, 497
pernio, 1040
treatment of, 1041
relapsing scarlatiniform, 1044
diagnosis of, 1044
from scarlatina, 1044
treatment of, 1044
simplex, 1039
symptomatic, 1041
traumaticum, 1040
tuberculatum, 1042
venenatum, 1040
vesiculosum, 1042
Erythematous syphiloderm, 1087
Eserine in ophthalmia neonatorum, 1131
in phlyctenular kerato-conjunctivitis, 1137
Essential shrinking of conjunctiva, 1136
Estlander's operation, 920
État mamelonné, 463
Ethmoiditis, necrosing, in etiology of nasal myxomata, 841
Ethyl iodide in asthma, 933
Eucalyptol in tuberculosis, 126
Eucalyptus in malaria, 334
Eustachian tube, formation of, 1102
Evacuation of bowels during urination in vesical calculus, 1014
Exalgin in chorea, 762
Examination of the mouth and fauces, 17
Exanthemata in etiology of acute tubal nephritis, 983
of bronchitis, 896
of chronic peritonitis, 584
of middle-ear inflammation, 1110
Exanthematous eruptions on eyelids, 1123
Excision in treatment of adherent prepuce, 1030
Exercise, 35, 53
hours for, 35
importance of rest during, 54
Exercise in childhood, 35
in chronic gastric catarrh, 467
in chronic heart disease, 956
in convalescence from acute nephritis, 990
in etiology of paroxysmal hæmaturia, 966
in functional affections of heart, 962
in infancy, 35, 53
in pseudo-hypertrophic muscular paralysis, 773
in pulmonary emphysema, 925
Expectoration in asthma, 930
in bronchitis, 900
in broncho-pneumonia, 879
in croupous pneumonia, 887
in fibroid phthisis, 937
in gangrene of lung, 894
in measles, 144
Expiratory dyspnœa, causes of, 10
respiration, character of, 10
significance of, 10
theory of compensatory emphysema, 922
of substantive emphysema, 924
Exploratory incision in chronic peritonitis, 586
Exploring needle in appendicitis, 530
Exposure in etiology of acute gastric catarrh, 458
of rheumatism, 367
External ear, affections of, 1103
Extra-cellular pigmented bodies in malaria, 322
Exudate in infectious pseudo-membranous tonsillitis, 434
Exudates, pleural, chemical composition of, 909
interchange of fluids in, 909
without microbic elements, 911
Exudation in tubercular meningitis, 627
Eye, diseases of, 1122
refraction of, in childhood, 1145
Eyelid, furuncle of, treatment of, 1122
Eyelids, abscess of, 1122
diseases of, 1122
ecchymosis of, 1128
emphysema of, 1128
injuries of, 1127
syphilis of, 1124
tumors and hypertrophies of, 1124
Eyes, treatment of, in measles, 152
Eye-strain in migraine, 721

F.

Face, expression of, in health and disease, 3
treatment of eczema of, 1053
Facial hemiatrophy, progressive, 775
symptoms of, 776
treatment of, 776
nerve, obstetric paralysis of, 83
paralysis, 774
diagnosis of, 775
etiology of, 774
in otitis media, 1117
symptoms of, 774
treatment of, 775
phenomenon in tetany, 766
Facies in asthma, 930
in bronchitis, 901
in hereditary ataxia, 818
in suppurative hepatitis, 570
in typhoid fever, 223
Fæcal accumulation, diagnosis of, 14
evacuations in catarrhal ulceration of the intestines, 8
in diarrhœa of sucklings, 8
in disease, 8
in dysentery, 8
in entero-colitis, 8
in follicular enteritis, 8
in health, 8
in helminthiasis, 8
in indigestion, 8
in intestinal catarrh, 8
in tubercular disease, 8
in tuberculous ulceration of the intestines, 8
in typhoid fever, 8
Fæces in jaundice, 559
Failure of heart, sudden, in diphtheria, 278
sources of, in sounding for stone, 1016
Fallopian tubes, tuberculosis of, 123
Faradism in simple jaundice of infants, 561
Farinaceous food, when permissible, 22
Fascia, cervical, deep, 292
superficial, 292
Fascicular keratitis, 1137
Fat, deficiency of, in food of rachitics, 339
in human milk, 44
in milk, 46
relative size of globules of, 46
Fatty calculus, 1010
degeneration, acute, of newborn, 92
Fauces, appearance of, in health, 17
ascarides in, 543
examination of, 17

Favus, 1092. See *Tinea favosa.*
Features of disease, 3
Febrile and post-febrile insanity, 706
Feeble-mindedness in infantile cerebral palsies, 656
Feeding, 18
after tracheotomy, 304
artificial, 21
asses' milk in, 25
attenuants in, 23
bicarbonate of sodium in, 23
goat's milk in, 25
lime-water in, 25
method of preparation in, 23
mode of administration of, 30
peptonization in, 25
position of child in, 31
preservation of milk for, 31
quantity of food for, 22
rules for, 21
selection of food for, 21
of milk for, 31
"strippings" in, 25
substitutes for milk in, 28
sugar of milk in, 23
table for, 24
vomiting in, 25
by wet-nurse, 20
from maternal breast, 18
duration of, 18
improper, in etiology of acute intestinal indigestion, 481
in acute milk infection, 494
in insanity, 708
in tuberculosis, 125
mixed, 19
Feet, enlargement of, in acromegaly, 691
Fehleisen, streptococcus of, 245
Fehling's solution, composition of, 972
qualitative test by, 972
quantitative test by, 973
Femur, changes in, in rachitis, 353
fracture of, at birth, 85
Fenestrated spring forceps for circumcision, 1031
Fermentation, butyric, 45
reaction of, 45
lactic, 45
bacteria in, 44
test for sugar, 973
Ferrum dialysatum in chronic tubal nephritis, 995
Fetor in atrophic rhinitis, 834
Fever. See *Temperature.*
in rheumatism, 368
scarlet. See *Scarlet fever.*
typhoid. See *Typhoid fever.*
Fever-blister. See *Herpes simplex.*
"Feverish" breath, 7
Fibrinous calculus, 1010
exudates in scarlatina, 163
diagnosis of, from diphtheria, 163
pleurisy, 908
Fibroid limitation of tubercle, 102
phthisis. See *Phthisis, fibroid.*
Fibrous deposits in chronic tympanic catarrh, 1119
nodules in rheumatism, 370, 950
Fibula, changes in, in rachitis, 353
Fièvre infectieuse tuberculeuse suraïgue, 104
Filaria sanguinis hominis a cause of chyluria, 967
a cause of hæmaturia, 965
Fish in diabetic diet, 975
Fissure of anus, 602
Fistula, fæcal, 592
after appendicitis, 531
in ano, 601
treatment of, 602
of lachrymal sac, 1144
Fistulæ, perineal, in congenital malformation of rectum, 597
Flagellate bodies in tertian malaria, 322
"Flat-chest," 448
"Flat-nose," 842
Flatulency in chronic intestinal indigestion, 484
Flour-ball, 51
preparation of, 24
Fluid in hydronephrosis, 1002
Fluorescine in diagnosis of corneal abrasion, 1141
Focal epilepsy, 747
symptoms in brain abscess, 634
Fœtal head, compression of, 83
rachitis, 338
Fœtus, rachitic, description of, 346
Follicular amygdalitis, diphtheritic nature of, 273
trachoma, 1134
ulceration of bowel, 497
Fontanelle, anterior, ossification of, 13
bruit of, in rachitis, 355
bulging of, 13
depressed, in chronic gastric catarrh, 464
in simple atrophy, 521
late closure of, in rickets, 347
puncture of, in hydrocephalus, 631
Food, average quantity of, for infants, 362
daily average of, for children, 362
daily quantity of, 22
in etiology of rachitis, 339
insufficiency of, 519
Food in treatment of constipation, 515
Food and drink admissible in diabetes mellitus, 975
Foods, artificial, chemistry of, 47
comparison of, 52
predigested, 29
to be avoided in diabetic diet, 975
Foramen ovale, patency of, 940
cause of, 941
Forceps, obstetric, injuries from, 83
limitations of, 83
precautions in using, 83
Foreign bodies in auditory canal, 1107
treatment of, 1108
in cæcum or appendix, 525
in cornea, 1141
in larynx, trachea, and bronchi, 865
diagnosis of, 866
from acute laryngitis, 866
from laryngeal obstruction by lymphatic enlargement, 867
from œdema of glottis, 867
prognosis of, 867
symptoms of, 865
treatment of, 867
in rectum, 611
body, impaction of, in tympanum, 1109
Forest's method of artificial respiration, 79
Fractures at birth, prognosis and treatment of, 85
in utero, 85
Freckles. See *Lentigo.*
Fremitus, hydatid, in renal cysts, 1000
vocal, in broncho-pneumonia, 880
French measles. See *Rubella.*
Fresh air in rachitis, 359
in tuberculosis, 124
Friction in massage, 57
Friction-sound in pleurisy, 914
in pericarditis, 947
Friedreich's disease, 815. See, also, *Ataxia, hereditary.*
Friedrichshall water in jaundice, 563
Fromentine in diabetes, 974
Fruehjahr's catarrh, 1133
Fruits in diabetic diet, 975
Fuchsin, Ziehl's solution of, 95
Fundus oculi, hæmorrhages in, in leukæmia, 390
Fungus of favus, microscopy of, 1093
of tinea trichophytina, 1096

Furuncle of auditory canal, 1105
treatment of, 1069, 1105
of eyelids, 1122
Furunculosis, 1068
post-eczematous, 1045
Furunculus, 1067
diagnosis of, 1068
from carbuncle, 1068
from syphiloderm, 1068
etiology of, 1068
prognosis of, 1068
treatment of, 1068

G.

Gait in hereditary ataxia, 818
in idiocy, 676
Gallic acid in diabetes insipidus, 978
Galton whistle in diagnosis of aural disease, 1120
Galvanism in alopecia areata, 1081
in constipation, 518
in diabetes insipidus, 978
in Raynaud's disease, 824
Galvano-cautery in lupus, 1086
in stomatitis mycosa, 423
in ulcer of cornea, 1139
puncture in enlarged tonsils, 439
Gangrene, diabetic, rarity of, in children, 972
in parotitis, 200
in vaccinia, 195
of lung, 891
etiology of, 891
following broncho-pneumonia, 878, 880
in tuberculosis, 892
pathology of, 893
symptoms of, 893
treatment of, 895
with chronic bronchitis, 892
with septic processes of ear, 892
with ulcerations in mouth, 892
symmetrical, 822. See, also, *Raynaud's disease.*
Gastric catarrh, acute, 457
diagnosis of, 460
from meningitis, 460
from pneumonia, 460
from scarlet fever, 460
from typhoid fever, 460
etiology of, 457
pathology of, 458
prognosis of, 461
symptoms of, 459
treatment of, 461
chronic, 462
course of, 465
diagnosis of, 465
from typhoid fever, 466
Gastric catarrh, chronic, etiology of, 462
in infancy, 464
pathology of, 462
prognosis of, 466
simulating pernicious anæmia, 465
symptoms of, 463
treatment of, 466
juice, action of, on milk, 21
ulcer, 468
etiology of, 468
prognosis of, 469
symptoms of, 468
treatment of, 469
Gastritis, atrophic, 466
chronic glandular. See *Gastric catarrh, chronic.*
mucous, 466
simple, 465
Gastro-adenitis, 457. See, also, *Gastric catarrh, acute.*
Gastro-intestinal catarrh. See *Milk infection, subacute.*
chronic. See *Mucous disease.*
tuberculosis following, 106
disorder in etiology of eclampsia, 742
of laryngismus, 859
of urticaria, 1064
hæmorrhage, 86
Gastro-malacia, 469
Gavage in dysentery, 508
Gelatin, preparation of, 23
Gelsemium in chronic blepharospasm, 1125
General development, 12
in health, 12
of the new-born child, 12
management of children, 18
Genital organs, involvement of, in parotitis, 200
Gerätubungen, 55
German measles. See *Rubella.*
Germicidal drugs in acute milk infection, 495
Giant-cells in tubercle, 102
Giddiness in brain abscess, 634
in cerebro-spinal meningitis, 231
Girdle sensation in acute myelitis, 784
in tumors of spinal cord, 802
Glands, anterior mediastinal, tuberculosis of, 108
axillary, swelling of, in vaccinia, 194
bronchial, enlargement of, in etiology of bronchitis, 897
enlargement of, in measles, 146
tuberculosis of, 108
cardiac, tuberculosis of, 108
disorders of, 1035
enlargement of, in lymphatic anæmia, 387
Glands, inguinal, enlargement of, in milk infection, 497
swelling of, in vaccinia, 194
in measles, 144
intercostal, tuberculosis of, 108
lymphatic, enlargement of, 13
in leukæmia, 391
mesenteric, tuberculosis of, 110
posterior mediastinal, tuberculosis of, 108
sternal, tuberculosis of, 108
tracheal, tuberculosis of, 108
tracheo-bronchial, tuberculosis of, 108
Glandular enlargements after vaccination, 195
in diphtheria, 278
with eczema, 1045
Glioma of orbit, 1145
Gliomata of brain and meninges, 637
Globus hystericus, 730
Gluten-flour in diabetes, 974
Glycerin in diuretic formulæ, 989
Goat's milk in artificial feeding, 25
Goitre with cretinism, 685
Gold and sodium chloride in chronic interstitial nephritis, 998
Gonococcus, diagnostic value of, 1025
of Neisser, 1129
value of, in diagnosis of vulvo-vaginitis, 1028
Gonorrhœa, ante-partum treatment of, 88
in male children, 1025
treatment of, 1026
of mouth, in new-born, 88
treatment of, 89
Gonorrhœal infection of new-born, 88
ophthalmia, 88
Gout in etiology of psoriasis, 1056
of vesical calculus, 1011
Gouty kidney. See *Nephritis, chronic interstitial,* 997
Grand movements, period of, in hysteria, 731
Granulations of wound after tracheotomy, 306
Grattage in trachoma, 1135
Gravel in bladder, symptoms of, 980
in diabetes insipidus, 978
Green stools in acute intestinal indigestion, 482
in chronic intestinal indigestion, 484
Grisolle sign in variola, 187
Growing pains, 758
Grunting expiration in bronchitis, 900

Grunting expiration, prognostic importance of, 902
Gum-lancing, danger of, 429
Gumma, 1088
of brain, 638
of iris, 1142
Gummata in hereditary syphilis, 648
Gummatous iritis, 1142
Gums, bleeding of, in scorbutus, 407
Gymnastics, 55
in hysteria, 740

H.

Habit chorea, 1125
due to eye-strain, 1146
Habits of life in etiology of chlorosis, 378
Hæmatemesis in tuberculosis of the bowels, 112
Hæmatogenous jaundice, 559
in new-born, 92
Hæmatoma of sterno-cleido-mastoid muscle, 72
Hæmatomata of auricle, 1104
Hæmaturia, 963
diagnosis of, from calculi, 964
from cystitis or pyelitis, 964
from hyperæmia of kidney, 964
from icteric urine, 963
from passive hyperæmia, 964
from tuberculosis of bladder, 964
in acute tubal nephritis, 964, 983
in malarial fever, 330
in scarlatinal nephritis, treatment of, 172
in scorbutus, 407
in tumors of kidney, 1008
in vesical calculus, 1014
paroxysmal, 966
Hæmic murmur in secondary anæmia, 377
Hæmoglobin, excess of, at birth, 76
percentage of, in chlorosis, 379
proportion of, in infancy, 375
Hæmoglobinuria, acute, of new-born, 92
in erysipelas, 249
in Raynaud's disease, 822
Hæmophilia, 393
etiology of, 393
hereditary transmission of, 393
morbid anatomy of, 393
prognosis of, 394
in females, 394
treatment of, 394
Hæmoptysis in chronic pulmonary tuberculosis, 119
in fibroid phthisis, 937
in gangrene of lung, 894
in tuberculosis, 101
Hæmorrhage after tonsillotomy, 442
cerebral, following asphyxia, 74
following labor, 74
forms of, 74
during tracheotomy, 301
fatal, after gum-lancing, 429
after tonsillotomy, 442
from kidney, 964
from mucous surfaces, blood-count in, 82
from vagina, 82
gastro-intestinal, 86
pathology of, 87
in abscission of the tonsils, 442
in infantile cerebral palsies, 658
in new-born, 73
causes of, 74
diagnosis of, 74
etiology of, 73
parenchymatous, 75
prophylaxis of, 75
intestinal, in scorbutus, 407
in typhoid fever, 221
meningeal, in infantile cerebral palsies, 657
multiple, following umbilical infection, 73
secondary, after tracheotomy, 305
subperiosteal, in scorbutus, 496
umbilical, 85
treatment of, 86
Hæmorrhages from mucous surfaces, 82
in cirrhosis of liver, 574
treatment of, 576
in jaundice, 560
from obliteration of bile-ducts, 562
in leukæmia, 390
in pertussis, 208
in whooping-cough, 206
of the skin, 1069
punctiform, in pernicious anæmia, 382
Hæmorrhagic pleurisy in morbus Werlhofii, 908
in scurvy, 908
Hæmorrhoids, 608
in cirrhosis of liver, 574
Halitosis, causes of, 7
Hall's method of artificial respiration, 79
Hands, enlargement of, in acromegaly, 691
Harrison's groove, 342, 351
Head, fœtal, compression of, 83
retraction of, in cerebral meningitis, 615
Headache, 718
diagnosis and prognosis of, 724
etiological varieties of, 723
in acute gastric catarrh, 459
in acute tubal nephritis, 983
in brain abscess, 634
in brain tumors, 638
in cerebral meningitis, 615
in cerebro-spinal meningitis, 231
in chicken-pox, 179
in chronic gastric catarrh, 463
in erysipelas, 247
in leukæmia, 390
in measles, 143
in rubella, 176
in tubercular meningitis, 628
in typhoid fever, 220, 222
in variola, 184
mechanism of, 718
persistent, in hereditary syphilis, 647
treatment of, 725
vertical, in chlorosis, 379
with tumors of spinal cord, 804
Headaches due to organic disease, 721
from eye-strain, 1146
Head-banging, 713
Head-louse, 1100
Head-nodding and head-jerking, 713
Hearing, mechanical aids to, 1121
Heart, congenital affections of, 940
symptoms of, 945
treatment of, 945
disease in etiology of chronic gastric catarrh, 463
chronic, 953
clinical history of, 953
etiology of, 953
prognosis of, 955
symptoms of, 953
treatment of, 956
functional affections of, 958
course of, 961
diagnosis of, 961
etiology of, 958
prognosis of, 961
symptoms of, 959
treatment of, 961
in diphtheria, 276
irregularity of, during sleep, 959
obstructive lesions of, in etiology of bronchitis, 897
organic diseases of, 946
peculiarities of, in childhood, 946
rapid, 960
relative weight of, 946
slow, 960
syphilis of, 130

Heart-action, irregularity of, in children, 959
Heart-consciousness, 960
Heat in interstitial keratitis, 1141
in ophthalmia neonatorum, 1131
Hebetude in adenoid vegetations, 447
Hebrew race, hæmophilia in, 393
Hemianæsthesia in hysteria, 733
in tumors of crura cerebri, 643
Hemianopsia in acromegaly, 691
in brain tumors, 642
in hysteria, 733
in infantile cerebral palsies, 653
in migraine, 719
Hemicrania. See *Migraine.*
Hemiplegia from obstetric injury, 83
in hereditary syphilis, 648
Henoch's disease, 400
Hepatitis, suppurative, 569
diagnosis of, 570
prognosis of, 571
treatment of, 571
with dysentery, 571
Hepatogenous jaundice, 559
Hereditary ataxic paraplegia, 815. See, also, *Ataxia, hereditary.*
syphilis. See *Syphilis, hereditary.*
Heredity in etiology of cleft palate, 450
of diabetes mellitus, 971
of eczema, 1046
of hysteria, 728
of laryngismus stridulus, 859
of leukæmia, 389
of myotonia, 688
of pemphigus, 1059
of pseudo-hypertrophic paralysis, 771
of psoriasis, 1056
of rachitis, 339
of Raynaud's disease, 823
of rheumatism, 367
of substantive emphysema, 923
of tubercular meningitis, 626
of vesical calculus, 1011
Hernia, cæcal, 552
umbilical, 86
Herpes facialis. See *Herpes simplex.*
febrilis. See *Herpes simplex.*
iris, 1043
labialis in croupous pneumonia, 887
of auricle, 1104
simplex, 1060
Herpes zoster, 1060, 1061
High operation in tracheotomy, 296
High-arched palate, 446
Hip-joint disease, premonitory symptoms of, 13
sea-air in, 64
Hives. See *Urticaria.*
Hoarseness in laryngeal disease, 6
"Holding-breath" spells, 356
Hordeolum, treatment of, 1122
Horse-pox, vaccination with virus of, 193
Hot bath in acute tubal nephritis, 987
douche in acute middle-ear inflammation, 1112
in chronic suppurating middle ear, 1115
in furuncle of auditory canal, 1105
in suppurating middle ear, 1114
Hot-air bath in acute tubal nephritis, 986
in scarlatinal nephritis, 171
Huguier's operation, 596
Humanized milk, 26, 48
analysis of, 49
Humerus, changes in, in rachitis, 352
fracture of, at birth, 85
"Hunger for oxygen," 76
Hunyadi water in jaundice, 563
Hutchinson's teeth, 138
Hydatid cysts of kidney, 1000
diagnosis of, 1001
pathology and symptoms of, 1000
prognosis of, 1001
treatment of, 1001
fluid from liver, 558
fremitus, 572
of liver, 571
tumor of omentum, 586
Hydræmia in etiology of ascites, 587
Hydragogue cathartics in chronic tubal nephritis, 995
Hydrencephalic cry, description of, 6
Hydrocephalic idiocy, 673
Hydrocephalus, acute, 626
chronic, 630
diagnosis of, 630
etiology of, 630
in hereditary syphilis, 648
prognosis of, 630
treatment of, 631
Hydrochloric acid, deficiency of, in acute gastric catarrh, 459
in cholera, 266
with pepsin, in chronic gastric catarrh, 467
Hydrogen peroxide in acute follicular tonsillitis, 435
in angina of variola, 189
in atrophic rhinitis, 836
in chronic suppurating middle ear, 1115
in diphtheria, 286
in eczema of auricle, 1105
in gonorrhœa of mouth, 89
in scarlet fever, 170
in whooping-cough, 212
Hydronephrosis, 1001
diagnosis of, from ascites, 1002
from ovarian cyst, 1002
from pyonephrosis and perinephric abscess, 1002
from renal cysts, 1002
etiology and pathology of, 1001
prognosis of, 1003
symptoms of, 1002
treatment of, 1003
Hydrophobophobia, 704
Hyoscine in chorea, 763
in epidemic cerebro-spinal meningitis, 235
Hyperæsthesia, in acute myelitis, 784
in cerebro-spinal meningitis, 233
in hysteria, 732
in Raynaud's disease, 821
in simple cerebro-spinal meningitis, 622
in tumors of spinal cord, 802
Hyperalgesia in hysteria, 732
Hyperidrosis, 1037
etiology of, 1037
prognosis of, 1038
treatment of, 1038
Hypermetropia in infancy and childhood, 1146
Hyperpyrexia in croupous pneumonia, 889
in measles, 153
in rheumatism of children, 368
in scarlet fever, 161
Hypertrophies of skin, 1072
Hypertrophy of fingers, 692
of right heart in fibroid phthisis, 938
of tonsils. See *Tonsils, hypertrophy of.*
Hypodermic administration of mercury in syphiloderma, 1090
puncture in diagnosis of pleural effusion, 916
safety of, in pleurisy, 916
Hypodermoclysis in cholera, 268
Hypophosphites in tuberculosis, 125
Hypopyon keratitis, 1139
Hypostatic congestion in typhoid fever, 222

Hysteria, 727
diagnosis of, 739
from epilepsy, 739
from organic paralysis, 740
etiology of, 728
interparoxysmal symptoms of, 732
paroxysmal symptoms of, 729
statistics of, in children, 728
symptoms of, 729
treatment of, 740
Hysterical headache, 724
Hystero-epilepsy, 730

I.

Ichthyosis, 1072
diagnosis of, 1073
etiology of, 1073
hystrix, 1072
prognosis of, 1073
simplex, 1072
treatment of, 1073
Icterus neonatorum, 87
physiological, of new-born, 87
Idiocy, 650, 669
accidental, 673
classification of, 672
pathological, 678
congenital, 672
developmental, 672
diagnosis of, 678
etiology of, 675
from obstetric injury, 83
legal definitions of, 670
pathology of, 677
prognosis of, 679
symptoms of, 676
treatment of, 679
Idiots savants, 672
Ignipuncture in enlarged tonsils, 439
Ileal intussusception, 533
Ileo-cæcal intussusception, 533
Ileo-colic intussusception, 533
Ileo-colitis. See *Dysentery.*
Imbecility, 669, 670
Immunity, artificial, in cholera, 256
in tuberculosis, 101
personal, from cholera, 256
Imperative acts or movements, 703
movements, etiology of, 716
diagnosis of, 716
in defective children, 712
prognosis of, 716
treatment of, 717
Impetigo contagiosa, 1061
after vaccination, 195
diagnosis of, 1063
etiology of, 1062
prognosis of, 1063
relation of, to vaccinia, 1063
treatment of, 1063
Improper feeding in etiology of acute gastric catarrh, 457
Incision and drainage in peritonitis, 583
in furuncle of auditory canal, 1105
in perinephritic abscess, 1006
in pleural effusion, 919
disadvantage of, 919
in treatment of hydatid of liver, 573
of hydatids of kidney, 1001
of drum-membrane, 1112
in suppurating middle ear, 1114
Incisions in operations for appendicitis, 530
Incontinence of urine, 968
spontaneous cure of, at puberty, 968
treatment of, 969
Incubator, Auvard's, 80
Indigestion, acute intestinal, 481
etiology of, 481
prognosis of, 482
synonyms of, 481
treatment of, 482
chronic intestinal, 483
diagnosis of, 485
etiology of, 483
prognosis of, 484
synonyms of, 483
treatment of, 486
of infants, dietetic treatment of, 29
Indigo calculus, 1010
Indolent corneal ulcers, 1138
Infancy, duration of, 1
Infantile cerebral palsies, 651
osteomalacia and cretinism, 684
paralysis, sea-air in, 65
Infants, chronic constipation in, 513
nursing, wasting in, 520
vaccination of, 196
Infants' foods, value of, 22
Infection by tubercle bacilli in milk, 110
in utero, 73
by tubercle bacilli, 90
by typhoid bacilli, 90
modes of, in cholera, 256
in measles, 141
of tracheotomy wound, 305
of typhoid fever by water, 216
septic, of new-born, 89
through umbilicus, 89
prophylaxis of, 89
treatment of, 89
tubercular, of new-born, 90
dog's serum in, 91
typhoid, of new-born, 90
Infections attacking the new-born, 88
Infections of blood in new-born, 92
Infectious diseases in etiology of pleurisy, 910
with parotitis, 199
Inflammation, sympathetic, of eye, 1143
Inflammations of skin, 1039
Inflammatory phenomena in vaccination, 195
Inflation in intussusception, 537
Influenza, epidemic, 236
bacteriology of, 236
circulatory symptoms in, 238
clinical history of, 238
complications and sequelæ of, 239
convalescence from, 241
definition of, 236
diagnosis of, 240
from bronchitis, 240
from meningitis, 240
from pneumonia, 240
from simple catarrh, 240
from typhoid fever, 240
disinfection in, 240
etiology of, 236
gastro-intestinal symptoms in, 239
incubation of, 237
in etiology of bronchitis, 896
in infants, 237
loss of weight in, 238
nervous symptoms in, 239
pathology of, 237
prognosis and mortality of, 240
respiratory symptoms in, 238
treatment of, 241
with parotitis, 200
Infusoria in gangrene of lung, 893
Injections in gonorrhœa, 1026
in intussusception, 537
intravascular, in cholera, 269
Injuries, obstetric, medico-legal aspect of, 83
treatment of, 84
Innutrition in etiology of bronchitis, 897
Insanity, 697
cataleptic, 701
choreic, 700
circular or alternating, 700
diagnosis of, 707
differences of, in child and adult, 697
epileptic, 701
general etiology of, 707
hysterical, 700
in children, 697
in infants, 697
moral, 702

Insanity, moral, treatment of, 710
primary delusional, 702
prognosis of, 708
treatment of, 708
varieties of, in children, 698
Insistent idea, 703
Inspection of chest, 15
Inspiration of amniotic liquid, 76
Inspiration-pneumonia, 76, 91
Inspiratory dyspnœa, 10
causes of, 10
theory of compensatory emphysema, 922
of substantive emphysema, 924
Instillations into auditory canal, 1113
Instinctive perversions, 702
Insufflation, mouth-to-mouth, 79
Internal ear, affections of, 1119
rarity of, in children, 1119
Interruption of stream in vesical calculus, 1014
Interstitial emphysema, 922
keratitis. See *Keratitis, interstitial.*
pneumonia. See *Phthisis, fibroid.*
Intertrigo in simple atrophy, 521
Intestinal antiseptics in dysentery, 508
in mucous disease, 475
in typhoid fever, 227
catarrh, chronic. See *Indigestion, chronic intestinal.*
lavage in acute milk infection, 493
parasites. See *Parasites, intestinal.*
Intestine, large, absence of, 599
Intestines, chronic diffuse tuberculosis of, 106
congenital malformations of, 591
tuberculosis of, 110
Intravascular injections in cholera, 269
Intubation of larynx, 311
accidents during and after, 315
after-treatment of, 316
feeding after, 316
indications for, 311
in spasmodic laryngitis, 856
in stenosis of larynx, 318
instruments for, 312
position of patient for, 314
preparations for, 313
prognosis in, 311
technique of, 314
unfavorable cases for, 318
Intubation-tubes, disinfection of, 317
removal of, 317
Intussusception, 533
chronic, 536
diagnosis of, 536
from appendicitis, 536
from colic, 536
from dysentery, 536
from enteritis, 536
from fæcal impaction, 536
from internal strangulation, 536
from suppurative peritonitis, 536
etiology of, 534
irreducible, 534
locality of, 533
morbid anatomy of, 534
prognosis of, 536
symptoms of, 535
treatment of, 537
Intussusceptions, double, 533
triple, 533
Intussusceptum, 533
Intussuscipiens, 533
Invagination of bowel. See *Intussusception.*
"Inward spasms" in simple atrophy, 522
Iodide of iron in bronchial catarrh of rachitis, 363
of potassium in syphilis, 140
Iodides in amyloid kidney, 997
in rheumatic pleurisy, 373
Iodine in acquired labyrinthine deafness, 1120
in chronic peritonitis, 585
in lupus vulgaris, 1084
Iodine-test in amyloid kidney, 996
Iodoform in scrofuloderma, 1087
in tuberculosis, 125
Ipecacuanha in bronchitis, 904
in broncho-pneumonia, 882
in congestion of liver, 567
in constipation, 516
in jaundice, 564
in spasmodic laryngitis, 851
Iris and ciliary body, diseases of, 1141
and ciliary region, injuries of, 1142
Iritis, 1142
in hereditary syphilis, 136
treatment of, 1142
Iron in anæmia after malarial fever, 334
in chlorosis, 380
in chronic heart disease, 957
in convalescence of mucous disease, 478
of rheumatism, 373
in lymphatic anæmia, 388
in phthisis, 126
Iron in purpura hæmorrhagica, 399
in secondary anæmia, 377
in splenic anæmia, 386
in syphilis, 140
in variola, 190
iodide, syrup of, in chronic peritonitis, 585
in lymphatism, 449
Irregular remittent fevers, 328. See *Remittent fevers, irregular.*
Irrigation in diphtheritic dysentery, 511
in naso-pharyngeal diphtheria, 285
intestinal, in dysentery, 509
in subacute milk infection, 499
method of, 510
of bowel in mucous disease, 476
of pleural cavity after resection, 920
of stomach in mucous disease, 476
Irritation, sympathetic, of eye, 1143
Ischio-rectal abscess, 604
Ischuria, hysterical, 735
Italians, frequency of rachitis among, 336
Itch. See *Scabies.*
Itching about anus with seat-worms, 546
in eczema, 1045
in jaundice, 559
treatment of, 564
Itch-mite, 1098

J.

Jaborandi in acute tubal nephritis, 986
in erysipelas, 250
in scarlatinal nephritis, 171
Jacksonian epilepsy, 747
Jalap in scarlatinal dropsy, 172
Jambul in diabetes mellitus, 977
Japanese, non-occurrence of rachitis among, 340
Jaundice, 559
diagnosis of, 560
from Addison's disease, 560
from chlorosis, 560
from malaria, 560
from pernicious anæmia, 560
due to congenital obliteration of bile-ducts, 561
epidemic, 561
etiology of, 559
following acute gastric catarrh, 460
from inflammation of umbilical vein, 561

Jaundice, hæmatogenic, in new-born, 92
in childhood, 563
in cirrhosis of liver, 574
in croupous pneumonia, 889
in hydatid of liver, 572
in new-born, 560
in Raynaud's disease, 823
in Winckel's disease, 562
simple, in infants, 559, 560
Jejunal intussusception, 533
Jellies in diabetic diet, 975
Joint affection in rheumatism, 368
swelling in hæmophilia, 393
Juvenile dementia from hereditary syphilis, 706

K.

Kaposi's disease, 1081
Katatonia, 701
Keratitis, interstitial, 1140
in late hereditary syphilis, 139
symptoms of, 1140
treatment of, 1141
punctata, 1142
purulent, 1138
Kerato-conjunctivitis, phlyctenular, 1136
etiology of, 1136
symptoms of, 1137
treatment of, 1137
Kidney, amyloid disease of. See *Amyloid disease of kidney.*
congenital cystic degeneration of, 999
hydatid cysts of, 1000
in diphtheria, 276
in malarial fever, 325
in rachitis, 343
in scarlet fever, 159
in typhoid fever, 221
large fatty, 993
large white, 993
lesions of, in cholera, 261
in diabetes mellitus, 971
tumors of. See *Tumors of kidney.*
Kidneys, chronic diffuse tuberculosis of, 106
syphilis of, 130
tuberculosis of, 122
"Kink" of whooping-cough, 206
Klebs-Loeffler bacillus, relations of, to diphtheria, 273
Kleptomania, 703
Knapp's roller-forceps, 1135
Knee-jerk in hereditary ataxia, 817
Köster's theory of congenital cystic degeneration of kidney, 999
Koumyss in typhoid fever, 226
Kousso against tæniæ, 553
Krull's method in jaundice, 564
Kussmaul's apparatus for irrigating stomach, 476
Kyphosis, 350
in syringomyelia, 813

L.

Labor, precipitate, injuries from, 84
Labyrinth, formation of, 1102
Labyrinthine lesion in total deafness, 1120
Lachrymal abscess, 1144
apparatus, diseases of, 1143
gland, abscess of, 1143
inflammation of, 1143
sac and duct, diseases of, 1143
sac, fistula of, 1144
Lactalbumin, 46
Lactation, commencement of, 18
Lactic acid, decomposition of, 45
in cholera, 266
in etiology of rheumatism, 367
presence of, in acute gastric catarrh, 459
Lactic-acid theory of rachitis, 340
Lactose, digestion of, 44
in human milk, 44
properties of, 44
Lacunæ of bone, 344
Lagophthalmos, 1126
Lamellar cataract. See *Cataract, congenital.*
Landry's paralysis, 798
Laparotomy for perforation in typhoid fever, 228
in intussusception, 538
Lardaceous disease, 996. See, also, *Amyloid disease of kidney.*
Laryngeal obstruction, 280
symptoms of, 290
in diphtheria, 280
Laryngismus stridulus, 857
complications of, 862
course and duration of, 861
diagnosis of, 862
from bilateral paralysis of glottis-dilators, 862
from spasmodic laryngitis, 862
etiology of, 858
in hereditary syphilis, 647
in rachitis, 356
paroxysm of, described, 861
pathology of, 860
prognosis of, 862
relation of, to tetany, 857
symptoms of, 860
Laryngismus stridulus, synonyms of, 857
treatment of, 862
Laryngitis, catarrhal, 844
etiology of, 845
in broncho-pneumonia, 845
in pulmonary phthisis, 845
in typhoid fever, 845
pathology of, 845
catarrhalis simplex, 846
complications of, 847
diagnosis of, 847
prognosis of, 847
treatment of, 847
diphtheritic, tracheotomy in, 293
in measles, 148
in typhoid fever, 221
spasmodic, 848
diagnosis of, 850
from laryngismus stridulus, 850
from true croup, 850
severe, 852
course of, 853
symptoms of, 852
treatment of, 854
prophylactic, 856
symptoms of, 848
treatment of, 850
Laryngotomy in treatment of foreign bodies in larynx and trachea, 868
Laryngo-tracheotomy in treatment of foreign bodies in larynx and trachea, 868
Larynx, ascarides in, 543
Lassar's paste, 1051
modification of, 1040
Lateral lithotomy, 1021
Lausedat's drops, 267
Lavage of stomach in cholera, 270
in chronic gastric catarrh, 467
Laxatives in pleurisy, 918
in subacute milk infection, 499
Lead, acetate of, in cholera, 268
Leeches in peritonitis, 582
in typhlitis, 529
in uræmic convulsions, 988
Lentigo, etiology of, 1072
treatment of, 1072
Leptomeningitis, acute spinal, 779
diagnosis of, 780
from hæmorrhage, 780
from myelitis, 780
from tetanus, 780
from tetany, 780
etiology of, 779
pathology of, 779
treatment of, 781

Leptomeningitis, chronic cerebral, 616
chronic spinal, 781
simple. See *Meningitis, simple.*
subacute cerebral. 616
Letzerich's bacillus, 398
Leucocytosis in hereditary syphilis. 134
Leucoderma, 1079
diagnosis of. 1079
from morphœa, 1080
from nerve-leprosy, 1080
from partial albinism, 1079
etiology of, 1079
prognosis of, 1080
treatment of. 1080
Leucoma, 1139
Leukæmia, 389
diagnosis of, 391
from pseudo-leukæmia, 391
from scrofulosis, 391
from splenic anæmia, 391
etiology of, 389
morbid anatomy of, 391
prognosis of, 392
treatment of, 392
Leyden's crystals in asthma, 929
Lichen planus, 1054
diagnosis of, 1055
etiology of, 1055
prognosis of, 1055
treatment of, 1055
scrofulosorum, 1086
tropicus, 1038. See *Miliaria.*
urticatus, relation of, to eczema, 1064
Lids, eczema of, 1054
phtheiriasis of, 1124
Liebig's foods, analysis of, 51
preparation of, 51
with milk, analysis of, 52
Ligaments, changes in, in rachitis. 342
Lime, saccharated solution of, formula for, 23
Linimentum exsiccans, 1051
Lipoma of peritoneum, 586
Lippitudo, 1123
Liquor potassæ in acid lithiasis, 981
Lithæmia, treatment of, in functional heart affections, 962
Lithia in treatment of vesical calculus, 1017
Lithiasis, 978, 979
diagnosis of. 981
etiology of, 980
prognosis of. 981
treatment of, 981
Lithium carbonate in diabetes mellitus, 976
Litholapaxy, 1018
advantages of, 1022
conclusions regarding, 1023
Litholapaxy in females, 1024
Lithotomy, 1018
lateral, 1021
emasculation after, 1021
median. 1021
suprapubic, 1020
in females. 1024
vaginal, 1024
Littre's operation, 596
Liver, amyloid disease of, 567
diagnosis of, 568
symptoms of, 568
treatment of, 568
apparent enlargement of, 557
chronic diffuse tuberculosis of. 106
cirrhosis of, 574
diagnosis of, 575
etiology of. 574
treatment of. 575
congestion of, 565
diseases of, 554
compared with adults, 554
diagnosis of, 557
general etiology of, 554
general symptomatology of, 555
physical examination in, 556
enlarged, diagnosis of, from tumor of kidney, 558
fatty, 567
treatment of, 567
hydatid of, 571
diagnosis of, 573
from pleural effusion, 573
prognosis of, 573
treatment of, 573
in infancy and childhood, 556
in pernicious anæmia, 383
malaria, 325
in rachitis, 342
in typhoid fever, 221
lesions of, in cholera, 261
in diphtheria, 276
operative exploration of, 558
palpation of, 557
passive congestion of, 566
percussion of, 557
pus from, 558
syphilitic inflammation of, 130, 568
diagnosis of, 569
treatment of, 569
tuberculosis of, 112
Liver-dulness, superior border of, 16
Local applications in erysipelas, 251
asphyxia, 821
and symmetrical gangrene. See *Raynaud's disease.*
syncope, 821
treatment of pertussis, 212
Localizing symptoms of brain tumors, 639
Locomotor ataxia in hereditary syphilis, 649
with syringomyelia, 813
Lordosis in pseudo-hypertrophic paralysis, 769
in syringomyelia, 813
Lotions in eczema, 1050
Low operation in tracheotomy, 296
Lumbar nephrotomy for pyonephrosis, 1004
pain in acute tubal nephritis, 983
Lung, abscess of, 895
fibroid induration of. See *Phthisis, fibroid.*
gangrene of, 891
Lungs, cirrhosis of. See *Phthisis, fibroid.*
hypostatic congestion of, in subacute milk infection, 497
lesions of, in diphtheria, 276
in pernicious malaria, 325
syphilis of, 129
tuberculosis of, 116
Lupus hypertrophicus, 1084
serpiginosus, 1084
verrucosus, 1084
vulgaris, 1083
diagnosis of, 1084
etiology of, 1084
prognosis of, 1084
treatment of, 1084
Luschka's tonsil, 444
Lustgarten, bacillus of, in syphilis, 127
Lymphadenitis, retropharyngeal. See *Retropharyngeal abscess.*
tracheotomy for, 443
Lymphadenoma of kidney, 1007
Lymphatic anæmia. See *Anæmia, lymphatic.*
glands, enlargement of, 13
Lymphatism in chronic follicuious pharyngitis, 434
in hypertrophy of tonsils, 438
Lymphocytes, 102

M.

Mackenzie's astringent mixture, 442
Macrocephalic idiocy, 673
Macula of cornea, 1139
Magnesium carbonate in constipation, 515
citrate in constipation, 515
Malaria in etiology of anæmia, 376
of leukæmia, 389
of urticaria, 1064
Malarial cachexia, 329
morbid anatomy of, 325
fever, 319

Malarial fever, astivo-autumnal type of, 328
parasites of, 323
conditions favorable to, 319
course and prognosis of, 333
diagnosis of, 331
from tuberculosis, 331
etiology and pathology of, 319
examination of blood in, 332
geographical distribution of, 319
morbid anatomy of, 324
pernicious, 330
prophylaxis of, 333
quartan, parasite of, 322
quotidian or double tertian, 327
relation of types of, to types of organism 320
specific micro-organism of, 320
symptoms of, 325
synonyms of, 319
tertian intermittent type of, 326
parasite of, 320
peculiarities of, in young children, 327
temperature in, 326
time of paroxysm of, 328
treatment of, 333
visceral affections associated with, 330
with typhoid, 331
hæmaturia, 965
hæmoglobinuria, theories of, 965
infection in Raynaud's disease, 823
Male fern against tæniæ, 553
Malformations, congenital, 84
diagnosis of, 85
simulating fracture, 84
of intestines, congenital, 591
causes of, 592
diagnosis of, 592
prognosis of, 592
treatment of, 592
of rectum and anus, congenital, 593
pathology of, 593
Malignant growths in cæcum, 532
measles, 152
Maltose, 45
Malt-sugar, 46
Management of children, 18
at sea-shore, 67
bathing in, 32
clothing in, 34
exercise in, 35
feeding in, 18
sleep in, 34
Mania, 699
Mania after influenza, 240
homicidal, 703
moral, 703
Marasmus. See *Atrophy, simple.*
Marginal abscess, 603
keratitis, 1137
Marie's disease, 690. See *Acromegaly.*
Marrow of bone, 344
of long bones in lymphatic anæmia, 388
Massage, direction of movement in, 57
duration of séance of, 57
in chorea, 59
in chronic gastro-intestinal catarrh, 58
in colic, 58
in constipation, 58, 518
in general debility and anæmia, 58
in incontinence of urine, 969
in infantile paralysis, 58
in pseudo-hypertrophic muscular paralysis, 773
in simple jaundice of infants, 561
in the new-born, 56
of cornea, 1140
physiological effect of, 57
position for, 56
technique of, 57
value of, 56
Mastitis in new-born, 91
Mastoid tenderness in suppurating middle ear, 1113
Masturbation from seat-worms, 546
Masturbational insanity, 706
treatment of, 710
Maternal influence in hereditary syphilis, 128
Maxillæ, changes in, in rachitis, 350
McBurney's point in typhlitis, 526
Measles, 141–154
black, 146
complications of, 147
decline of, 146
definition of, 141
diagnosis of, 148
from acute catarrh, 148
from eczema, 149
from rubella, 149
from scarlatina, 149
from syphilitic roseola, 149
from variola, 149
eruption of, 144
etiology of, 141
experimental inoculation of, 141
followed by tuberculosis, 106
hybrid. See *Rubella.*
incubation of, 142
in etiology of bronchitis, 896
of chronic tubal nephritis, 991
Measles, malignant, 146, 152
modified forms of, 146
morbid anatomy of, 142
mortality of, 150
prognosis of, 149
quarantine in, 154
relapses and second attacks of, 150
sequelæ of, 148
symptoms of, 143
treatment of, 150
with pertussis, 208
with whooping-cough, 148
without catarrh, 146
without eruption, 146
Meats in diabetic diet, 975
Mechanism of paroxysms of spasmodic laryngitis, 849
Meckel's diverticulum, 591
in intussusception, 533
Meconium, vomiting of, 592
Median lithotomy, 1021
Melæna in tuberculosis of the bowels, 112
neonatorum, 92
ulcer of duodenum in, 92
Melancholia, 699
agitated, 699
treatment of, 709
Menière symptoms in internal ear disease, 1120
Meninges, involvement of, in chronic suppuration of middle ear, 1117
Meningitis, basilar. See *Meningitis, tubercular.*
following operation, 614
cerebral, simple, 612
diagnosis of, 617
from cerebral pneumonia, 617
from middle-ear disease, 617
from pyæmia, 618
from tubercular meningitis, 617
from typhoid fever, 618
etiology of, 612
morbid anatomy of, 613
prognosis of, 618
symptoms of, 614
treatment of, 618
cerebro-spinal, simple, 621
diagnosis of, 623
from tetanus, 624
from tubercular, 624
from typhoid fever, 624
distinguished from cerebro-spinal fever, 621
etiology of, 621
prognosis of, 624
symptoms of, 621
treatment of, 624
pneumonic, lesions in, 614
spinal, 777
syphilitic, diagnosis of, from tubercular, 648

Meningitis, tubercular, 620
diagnosis of, 628
from brain tumor, 629
from cerebro-spinal meningitis, 629
from ear disease, 629
from hydrocephaloid state, 629
from simple meningitis, 629
from syphilitic meningitis, 629
from typhoid fever, 629
from uræmia, 629
etiology of, 626
pathology of, 626
prognosis of, 628
treatment of, 629
with parotitis, 199
Mental changes in brain tumor, 639
Menthol in tuberculosis, 126
Mercurial ointment in peritonitis, 582
stomatitis, resemblance of, to stomatitis ulcerosa, 418
Mercurials in diphtheria, 284
Mercuric chloride in chronic interstitial nephritis, 998
in ophthalmia neonatorum, 1131
Mercuric-chloride baths in syphiloderma, 1090
solution in corneal ulcer, 1139
Mercury in acquired labyrinthine deafness, 1120
in acute myelitis, 787
in acute spinal leptomeningitis, 781
in cerebral meningitis, 619
in chronic peritonitis, 585
in hereditary syphilis, 139
in interstitial keratitis, 1141
in syphiloderma, 1090
Mesenteric glands, chronic diffuse tuberculosis of, 106
swelling of, in typhoid fever, 218
tuberculosis of, 110
Mesenteron, 593
Methylene blue, Gabbet-Ernst's solution of, 95
in malaria, 334
Microcephalic idiocy, 673
Micrococci in meconium, 488
Micrococcus of Fehleisen, 90
Micro-organisms in etiology of eczema, 1047
in measles, 142
in spinal fluid in acute leptomeningitis, 779
in whooping-cough, 204
Micturition, frequent, in diabetes mellitus, 971
in gravel, 980
in hydronephrosis, 1002
in vesical calculus, 1114
Micturition, painful, causes of, 9
Middle ear, acute simple inflammation of, 1110
diagnosis of, 1112
acute suppurative inflammation of, 1113
symptoms of, 1113
affections of, 1110
chronic catarrh of, 1118
chronic suppuration of, 1114
stages of inflammation of, 1112
Migraine, 719
diagnosis of, 720
etiology of, 720
pathology of, 720
treatment of, 720
Miliaria, 1038
crystallina, 1038
diagnosis of, 1039
from eczema papulosum, 1039
from varicella, 1039
from vesicular eczema, 1039
etiology of, 1038
in rachitis, 355
papulosa, 1038
treatment of, 1039
vesiculosa, 1038
Miliary tuberculosis, acute, 103
Milium, 1037, 1127
etiology of, 1037
prognosis of, 1037
treatment of, 1037
Milk, albuminoids in, 46
as a culture-medium, 488
as a source of typhoid infection, 216
breast-, 19
casein in, 46
chemistry of, 37
commercial bottled, 38
compared with other foods, 37
composition of, 37
condensed, 49
dilution of, for food, 47
with lime-water, 47
fat in, 46
human, albuminoids in, 41, 44
color of, 41
comparison with cow's, 41
constancy of composition of, 41
reaction of, 41
specific gravity of, 41
table of analyses of, 42, 43
taste of, 41
humanized, 48
in acute tubal nephritis, 990
infection, 487
acute, 491–495
diagnosis of, 493
Milk infection, acute, diagnosis of, from cholera, 493
from sunstroke, 493
etiology of, 491
from condensed milk, 491
prognosis of, 493
season of, 491
synonyms of, 491
treatment of, 493
advantages of the term, 481
subacute, 495
complications of, 497
diagnosis of, 498
from chronic intestinal indigestion, 498
from intussusception, 498
dietetic treatment of, 498
etiology of, 495
prognosis of, 498
prophylaxis of, 498
synonyms of, 495
treatment of, 498
inorganic matter in, 46
analysis of, 47
legal standard of, in various States, 40
peptonized, characters of, 25
prohibited in acute milk infection, 493
in subacute milk infection, 498
prophylactic precautions in marketing, 489
sound dairy, analysis of, 40
characteristics of, 40
sterilization of, 26, 39, 47
transportation of, 31
Milkers, accidental inoculation of, with vaccinia, 192
Milk-secretion, diminished, treatment of, 20
Milk-sugar, 46
Milk-teeth, appearance of, 17
Mitral obstructive murmur, 954
regurgitant murmur, 953
regurgitation, 953
prognosis of, 955
stenosis, 954
prognosis of, 956
Mixed feeding, 19
or fusible phosphate calculus, 1010
treatment in syphilis, 140
Molluscum contagiosum of eyelids, 1127
epitheliale, 1073
diagnosis of, 1074
etiology of, 1073
treatment of, 1074
Monas scarlatinosum, 156
Mongolian idiots, 673
Monomania, suicidal, 703

Monophobia, 704
Monsel's solution in hæmophilia, 324
Morbid fears, 704
impulses, 702
movements in infantile cerebral palsies, 654
propensities, 703
Morbus cæruleus, 5
maculosus. See *Purpura hæmorrhagica*.
Morphine in asthma, 932
in diphtheria, 284
in phthisis, 126
Morphœa, 1078
diagnosis of, from keloid, 1078
from leprosy, 1078
from leucoderma, 1078
etiology of, 1078
prognosis of, 1079
treatment of, 1079
Mortality of first year, 68
Motor symptoms of syringomyelia, 812
Mouth, changes in, in disease, 17
cleansing of, at birth, 78
diseases of, 412
general etiology of, 412
examination of, 17
exanthematous eruptions in, 18
inflammation of, changes in, 18
mucous membrane of, in health, 17
of the infant, 412
primary syphilitic lesions of, 424
secondary syphilitic lesions of, 424
Mouth-breathing in adenoid vegetations, 445
in hypertrophic rhinitis, 831
with enlarged tonsils, 439
Mouth-suction of tracheotomy wound, 300
Muco-pus in urine in vesical calculus, 1015
Mucous disease, 470
appetite in, 472
breath in 472
diagnosis of, 473
from ascaris lumbricoides, 473
from dysentery, 473
from pulmonary tuberculosis, 473
diet in, 474
etiology of, 470
microscopy of stools in, 473
morbid anatomy of, 473
mucus in stools of, 472
nervous symptoms of, 472
nervous theory of, 471
pain in, 472
prognosis of, 474
Mucous disease, skin in, 472
symptoms of, 471
synonyms of, 470
temperature in, 472
tongue in, 471
treatment of, 474
urine in, 472
membranes, changes in, in rachitis, 342
lesions of erysipelas in, 246
patches, treatment of, 1091
surfaces, hæmorrhages from, 82
Mucus, hypersecretion of, in chronic gastric catarrh, 462
Mulberry calculus. See *Oxalate-of-lime calculus*.
Mulls, plaster and salve, of Unna, in eczema, 1052
Mumps. See *Parotitis*.
Murmur in acute endocarditis, 951
in aortic regurgitation, 955
in aortic stenosis, 954
in mitral regurgitation, 953
in mitral stenosis, 954
in stenosis of pulmonary artery, 943
in tricuspid regurgitation, 955
Murmurs, hæmic, in chlorosis, 379
in leukæmia, 390
in pernicious anæmia, 382
in anomalies of auriculo-ventricular orifices, 942
transient, in rapid or irregular hearts, 959
Muscular atrophy in hereditary ataxia, 818
with tumors of spinal cord, 803
power in hereditary ataxia, 818
rheumatism. See *Rheumatism, muscular*.
Musk in diphtheria, 283
Mussey's modification of Whitehead gag, 452
Mustard-bath in malignant measles, 152
Mydriatics in treatment of concomitant convergent strabismus, 1147
Myelitis, 782
acute, 782
diagnosis of, 786
etiology of, 782
pathology of, 783
treatment of, 785
chronic, 787
with simple cerebro-spinal meningitis, 622
Myopathic atrophy, infantile type of, 771
juvenile type of, 771
Myopia, infrequency of, in childhood, 1146
Myo-sarcoma of kidney, 1007
Myositis, syphilitic, 135
Myotatic excitability in hereditary ataxia, 817
Myotonia, 687
diagnosis of, 689
etiology of, 688
pathology of, 688
treatment of, 689
Myotonic reaction, 688
Myotonus with tumors of spinal cord, 803
Mysophobia, 704
Myxomata, nasal, 837
etiology of, 838
morbid anatomy of, 841
treatment of, 841
Myxo-sarcoma of kidney, 1007

N.

Nævi of eyelids, 1124
Nævus pigmentosus, 1075
etiology of, 1075
prognosis of, 1075
treatment of, 1075
pilosus, 1075
spilus, 1075
vascularis, 1081
diagnosis of, 1082
etiology of, 1082
prognosis of, 1082
treatment of, 1082
verrucosus, 1075
Naphthaline in cholera, 266
in jaundice, 565
in mucous disease, 476
in typhoid fever, 227
Naphthol in ichthyosis, 1073
Narrowing of rectum, congenital, 594
Nasal catarrh, chronic, after scarlatina, 166
in etiology of chronic catarrh of middle ear, 1118
douche in etiology of middle-ear inflammation, 1110
myxomata, 837
stenosis, 830
Naso-pharyngeal adenoid hypertrophy, 444
etiology of, 445
histology of, 444
treatment of, 448
Naso-pharyngitis, 431
Naso-pharynx, local treatment of, in variola, 189
Nausea, 9
and vomiting in brain-tumors, 639
in chronic gastric catarrh, 463
in vaccinia, 194
Nebula of cornea, 1139
Neck, anterior region of, anatomy of, 292

Neck, arteries of, concerned in tracheotomy, 292
Necrosis of temporal bone in chronic inflammation of middle ear, 1117
Negroes, frequency of rachitis among, 336
rarity of trachoma among, 1134
Nélaton's operation, 538
Neoplasms as a cause of hæmaturia, 964
Nephrectomy for hydronephrosis, 1003
for pyonephrosis, 1004
in children, 1009
in tumors of kidney, 1008
Nephritic colic, 1114
Nephritis, acute tubal, 983
diagnosis of, 984
from chronic nephritis, 984
from cyanotic induration, 984
etiology of, 983
morbid anatomy of, 984
prognosis of, 985
synonyms of, 983
treatment of, 985
chronic interstitial, 997
etiology of, 997
morbid anatomy of, 998
prognosis of, 998
rarity of, in childhood, 997
synonyms of, 997
treatment of, 998
chronic tubal, 990
diagnosis of, 992
from amyloid kidney, 992
from chronic interstitial nephritis, 992
from cyanotic induration, 992
etiology of, 990
morbid anatomy of, 992
in first stage, 992
in second stage, 993
in third stage, 993
prognosis of, 993
in first stage, 993
in second stage, 994
in third stage, 994
synonyms of, 990
treatment of, 994
of convalescence from, 994
complicating croupous pneumonia, 889
in cirrhosis of liver, 574
in late hereditary syphilis, 139
in parotitis, 200
in subacute milk infection, 497
in suppurative hepatitis, 570
scarlatinal. See *Scarlatinal nephritis.*
Nephritis with parotitis, 199
Nephrotomy for hydronephrosis, 1003
Nerve, superior laryngeal, irritation of, in pertussis, 205
Nerves, peripheral, affections of, in hereditary syphilis, 649
disorders of, in tetany, 765
Nervous diseases in causation of chronic constipation, 513
symptoms in bronchitis, 901
system, influence of, in childhood, 1
obstetric injuries to, 82
Nettle-rash. See *Urticaria.*
Neuritic headache, 724
Neuritis, multiple, after parotitis, 200
complicating epidemic cerebro-spinal meningitis, 233
peripheral, after diphtheria, 281
New growths of skin, 1081
New-born, hæmorrhage in, 73
Night-dress for summer, 34
for winter, 34
Night-terrors due to eye-strain, 1146
Nipples, india-rubber, 30
Nitre in hydatids of kidney, 1001
Nitre-paper in asthma, 933
Nitro-glycerin in asthma, 933
in atelectasis, 875
in diphtheria, 284
in scarlet fever, 172
Nitro-muriatic acid in oxalate-of-lime lithiasis, 982
Nocturnal epilepsy, 751
Noma, 421. See, also, *Stomatitis gangrenosa.*
Nomenclature of affections of middle ear, 1110
Nose, diseases of, 826
Nose-picking with tæniæ, 551
Nursing, importance of regularity in, 18
intervals between, 18
proper position in, 18
woman, diet of, 44
Nursing-bottle, care of, 30
graduated, 30
improper form of, 519
Nutrolactis, 360
Nuts in diabetic diet, 975
Nux vomica in chronic gastric catarrh, 467
in chronic intestinal indigestion, 487
in functional heart affections, 961
in incontinence of urine, 969
in night-sweats, 126
in simple atrophy, 523
Nux vomica in typhoid fever, 229
Nymphomania, 703
Nystagmus, 715
in albinos, 1079
in hereditary ataxia, 818
in infantile cerebral palsies, 654

O.

Obstetric forceps, injuries from, 83
prognosis of, 84
limitations of, 83
precautions in using, 83
injuries, medico-legal aspect of, 83
treatment of, 84
paralysis, 82
Obstruction, laryngeal, symptoms of, 290
Obturator for cleft palate, 451
Occlusion of anus, complete, 594
Oculo-motor symptoms in syringomyelia, 813
Odor in favus, 1093
in stomatitis gangrenosa, 422
of breath in gangrene of lung, 894
Œdema, 13
cardiac variety of, 13
fugitive, 1128
hepatic variety of, 13
in chlorosis, 379
in chronic heart disease, 953
in progressive pernicious anæmia, 381
in scarlatinal nephritis, 165
in secondary anæmia, 377
in tumors of kidney, 1008
localized, in scarlatinal nephritis, 166
in suppurative hepatitis, 569
of eyelids, 1127
in renal and cardiac disease, 1128
of glottis in pertussis, 208
of lungs in acute tubal nephritis, 984
in chronic tubal nephritis, 992
of neck after tracheotomy, 305
renal variety of, 13
Œsophagismus, 735
Œsophagus, perforation of, 109
Offensive breath, causes of, 7
Oïdium albicans, 416
Ointments, application of, 1051
in eczema, 1050
Oleum phosphoratum in rachitis, 365
Omentum, tumors of. See *Peritoneum, tumors of.*
Onychia, syphilitic, 136
Oögonia of Ferrán, 255

Operative treatment of concomitant convergent strabismus, 1147
Ophthalmia in measles, 148
neonatorum, 88, 1129
prognosis of, 1130
prophylaxis of, 88, 1132
results of, 1130
symptoms of, 1130
treatment of, 1130
phlyctenular. See *Kerato-conjunctivitis, phlyctenular.*
Opisthotonos, cervical, in cerebral meningitis, 616
in cerebro-spinal meningitis, 232
with tumors of spinal cord, 803
Opium in acute endocarditis, 952
in acute intestinal indigestion, 483
in bronchitis, 903
in cerebral meningitis, 620
in cerebro-spinal meningitis, 624
in cholera, 268
in chronic heart disease, 957
in croupous pneumonia, 890
in diabetes insipidus, 978
in diabetes mellitus, 976
in epidemic cerebro-spinal meningitis, 235
in intussusception, 537
in pericarditis, 948
in peritonitis, 583
in pertussis, 211
in purpura hæmorrhagica, 399
in rheumatism, 373
in therapeutics of childhood, 35
in tubercular meningitis, 630
in typhlitis, 529
Optic atrophy in hereditary ataxia, 818
in hydrocephalus, 630
disk, appearance of, with tumors of cord, 804
neuritis after erysipelas, 249
in brain abscess, 634
in brain tumors, 639
in cerebral meningitis, 615
in simple cerebro-spinal meningitis, 622
Orange-juice in scorbutus, 410
Orbit, bleeding in, 1145
caries of, 1144
cellulitis of, 1144
cysts of, 1145
diseases of, 1144
morbid growths of, 1145
periostitis of, 1144
Osseous system, alterations of, in rachitis, 344
in health, 343
Ossicles of ear, caries of, 1116
stiffening of the ligaments of, 1119
Osteo-chondritis, syphilitic, 130
Osteoplasty, 452
Otic vesicle, 1102
Otitis in influenza, 239
in measles, 148
in scarlatinal nephritis, 167
in typhoid fever, 222
in variola, 187
Ova of pediculus capitis, 1100
Ovaries, tuberculosis of, 123
Over-exercise, 55
fever from, 55
Over-feeding in etiology of acute intestinal indigestion, 481
of eczema, 1046
Over-work, phenomena of, 55
Ovoid bodies in æstivo-autumnal fever, 324
Oxalate-of-lime calculus, 1010
sediments in urine, 978
Ox-gall in constipation, 516
Oxyuris vermicularis, 545
diagnosis of, 547
habitat of, 545
method of infection by, 545
ova of, 545
treatment of, 547
Ozæna, 833
Ozone in sea-air, 60

P.

Pachymeningitis externa, 777
interna, 778
Pagenstecher's ointment, 1140
Pain in acute myelitis, 784
in acute poliomyelitis, 791
in chronic gastric catarrh, 465
in chronic heart disease, 953
in chronic peritonitis, 584
in croupous pneumonia, 887
in diseases of liver, 555
diagnosis of, from pleurisy, 556
from pleurodynia, 556
in intussusception, 535
in mitral stenosis, 954
in pericarditis, 947
in peritonitis, 581
in Raynaud's disease, 821
in simple cerebro-spinal meningitis, 622
in suppurative hepatitis, 569
in tumors of kidney, 1007
of spinal cord, 802
in typhlitis, 526
in vesical calculus, 1014
post-typhoid, 223
Painful micturition, 9
Paints in eczema, 1053
Palate, soft, appearance of, 17
Pallor in chronic tubal nephritis, 992
Palpation of chest, 16
Palpitation in chlorosis, 379
in chronic heart disease, 953
in mitral stenosis, 954
in pericarditis, 947
of heart, 961
Palsies, cerebral, acquired, 653
infantile cerebral, 651
diagnosis of, differential, 658
etiology of, 652
morbid anatomy of, 656
prognosis of, 658
statistics of, 652
symptoms of, 653
treatment of, 658
occurring during parturition, 653
of pre-natal origin, 652
Palsy of brachial plexus in hereditary syphilis, 649
Pancreas, syphilis of, 130
Pancreatic disease, relation of, to diabetes mellitus, 971
juice in new-born, 479
Pancreatin in jaundice, 564
in simple atrophy, 523
Pannus, 1134
phlyctenular, 1137
Panophthalmitis from ophthalmia neonatorum, 1130
Pantophobia, 704
Papilla of tooth, 426
Papillary trachoma, 1134
Papular syphiloderm, 1088
Papules in stomatitis syphilitica, 425
Paracentesis abdominis in ascites, 590
in ascites of cirrhosis of liver, 577
in chronic peritonitis, 585
of cornea, 1139
of drum-membrane, 1113
pericardii, 949
Paradoxical pulse, 960
Paræsthesia in Landry's paralysis, 799
in Raynaud's disease, 821
in tumors of spinal cord, 802
Paralexia, 661
Paralysis, diphtheritic, 281
treatment of, 288
facial, 774
hysterical, 734
in acute gastric catarrh, 460
in acute spinal leptomeningitis, 780
in cerebral meningitis, 615
in cerebro-spinal meningitis, 232
infantile, 789
in measles, 148
in tubercular meningitis, 628

Paralysis, Landry's, 798
diagnosis of, 799
from myelitis, 799
etiology of, 798
pathology of, 798
prognosis of, 799
symptoms of, 798
treatment of, 799
local, in simple cerebrospinal meningitis, 623
obstetric, 82
rachitic, 358
with tumors of spinal cord, 803
Paramimia, 661
Paranephric cyst, 1000
Paranoia, 702
Paraphimosis, 1032
Paraplegia in acute spinal leptomeningitis, 780
in hereditary syphilis, 649
partial, in variola, 184
Parasites, intestinal, 540
Parasitic affections of skin, 1092
Parenchymatous keratitis. See *Keratitis, interstitial.*
nephritis, acute. See *Nephritis, acute tubal.*
chronic. See *Nephritis, chronic tubal.*
Paresis with tumors of spinal cord, 803
Paretic dementia, 705
Parker's soda solution, 302
Parotitis, 197
bacillus of, 198
bacterium in, 198
complications of, 200
conditions of infection in, 199
definition of, 197
epidemics of, 197
etiology of, 198
incubation of, 199
infectious, etiology of, 198
in influenza, 239
in typhoid fever, 220
involvement of other glands in, 200
micrococci in, 198
pathological anatomy of, 197
period of greatest contagiousness of, 201
quarantine in, 201
traumatic, 197
etiology of, 198
treatment of, 200
Paroxysmal hæmaturia, 966
Parrot's disease, 650
nodes, 132
Passionate movements, period of, in hysteria, 731
Pastes in eczema, 1051
Pasteurization, 28, 48
Patency of foramen ovale, 940
Patent foods in etiology of scorbutus, 405
Paternal influence in hereditary syphilis, 127
Pathophobia, 704
Pavor nocturnus with pinworms, 546
Pediculosis, 1100
etiology of, 1101
treatment of, 1101
Pediculus capitis, 1100
pubis on eyebrows, 1124
Pelletierine against tæniæ, 552
Pelvic bones, changes in, in rachitis, 352
Pelvimetry, 74
Pemphigus, 1058
diagnosis of, 1059
etiology of, 1059
foliaceus, 1059
of conjunctiva, 1136
prognosis of, 1059
treatment of, 1059
vulgaris, 1058
Pepsin in diphtheria, 286
Peptogenic milk-powder, 26, 48
method of using, 48
Peptones, formation of, 45
Peptonization in artificial feeding, 25
partial, advantages of, 26
Peptonized milk, characters of, 25
Peptonoids, liquid, in typhoid fever, 226
Percussion of chest, 16
method of, in child, 16
resonance in health, 16
Perforation of bowel in catarrhal dysentery, 502
in typhoid fever, 218
of cæcum or appendix, diagnosis of, 528
Pericarditis, 946
complicating croupous pneumonia, 889
during scleroderma, 1077
etiology of, 947
in rheumatism, 369
in scarlatinal nephritis, 166
in typhoid fever, 222
in variola, 187
physical signs in, 947
prognosis of, 948
treatment of, 948
tuberculous, 122
without liquid effusion, 369
Perinephritic abscess, 1004
diagnosis of, 1005
etiology and pathology of, 1004
prognosis of, 1005
symptoms of, 1005
treatment of, 1006
Periostitis in late hereditary syphilis, 138
in typhoid fever, 223
nodular, in rheumatism, 368
of orbit, 1144
syphilitic, 131
Periproctitis, 604
Peritoneum, tumors of, 586
prognosis of, 587
treatment of, 587
Peritonitis, acute, 579
diagnosis of, 582
etiology of, 579
morbid anatomy of, 580
prognosis of, 582
treatment of, 582
ulceration of pus from, 581
chronic, 584
diagnosis of, 585
from tubercular peritonitis, 585
etiology of, 584
prognosis of, 585
treatment of, 585
chronic adhesive tuberculous, 114
diagnosis of, 115
prognosis of, 115
treatment of, 115
in intussusception, 534
in new-born, 90, 579
in typhoid fever, 221
in utero, 579
tuberculous, 112
ascitic form of, 113
morbid anatomy of, 112
ulcerative form of, 114
Peritonsillar abscess, 437
diagnosis of, 437
etiology of, 437
evacuation of, 438
prognosis of, 437
treatment of, 437
Perityphlitis, 525
Permanent teeth, 17
order of appearance of, 427
Pernicious malarial fever, 330
Persistence of ductus arteriosus, 943
Perspiration in rachitis, 341, 354
profuse, in etiology of constipation, 513
Pertussis, 210. See *Whooping-cough.*
in etiology of bronchitis, 896
of mucous disease, 470
Petechiæ in cholera, 264
in invasion of variola, 184
significance of, 184
Petechial fever. See *Cerebrospinal meningitis, epidemic.*
Petit mal, 751
Pétrissage, 51
Peyer's patches in typhoid fever, 217
Pharyngitis, acute, 431
diagnosis of, 431
etiology of, 431
pathology and symptoms of, 431
prognosis of, 432
treatment of, 432

Pharyngitis, chronic, 433
treatment of, 433
follicuious, acute, 431
chronic, 434
treatment of, 434
in scarlet fever, 161
lateralis, 434
Pharynx, appearance of, in health, 17
Phenacetin in acute follicuious tonsillitis, 436
in bronchitis, 904
in diabetes mellitus, 976
in eczema, 1049
in endocarditis, 952
in epidemic cerebro-spinal meningitis, 235
in measles, 153
in migraine, 720
in parotitis, 200
in pleurisy, 918
in pyrexia of broncho-pneumonia, 884
in scarlet fever, 170
in typhoid fever, 227
in whooping-cough, 212
Phimosis, 1029
as a cause of enuresis, 970
secondary, 1031
Phlebitis in typhoid fever, 222
umbilical, 89
Phlegmon of orbit, 1144
Phlegmonous ulceration in vaccinia, 195
Phlyctenular kerato-conjunctivitis, 1136
pannus, 1137
ulcers, 1137
Phlyctenule, 1136
Phobias, 704
Phosphatic sediments in urine, 978
Phosphorus in laryngismus stridulus, 864
in rachitis, 363
Photophobia in cerebral meningitis, 615
in cerebro-spinal meningitis, 232
in simple conjunctivitis, 1129
in spring catarrh, 1133
Photopsia in migraine, 719
Phtheiriasis of lids, 1124
treatment of, 1124
Phthisis, fibroid, 935
diagnosis of, 938
from chronic pleurisy, 938
from pulmonary tuberculosis, 938
etiology of, 935
morbid anatomy of, 936
prognosis of, 938
symptoms and course of, 937
treatment of, 938
pulmonalis. See *Tuberculosis, pulmonary.*
Phthisis pulmonalis in etiology of amyloid kidney, 996
Physical examination, order of examination in, 9
Physiognomy of adenoid vegetations, 446
Pick's linimentum exsiccans, 1052
paste, 1040
"Pigeon-breast" deformity, 448
Pilocarpine in acquired labyrinthine deafness, 1120
in acute tubal nephritis, 986
in asthma, 933
in chronic tubal nephritis, 994
in erysipelas, 250
in jaundice, 564
in scarlatinal nephritis, 171
in spasmodic laryngitis, 851
Pin-worm. See *Oxyuris vermicularis.*
Piperadzin in lithiasis, 982
Pityriasis rosea, 1066
diagnosis of, 1066
from circinate syphilide, 1066
from ringworm, 1066
from seborrhœa, 1066
etiology of, 1066
prognosis of, 1066
treatment of, 1066
Placenta, syphilis of, 129
tuberculosis of, 97
Plagiocephalic idiocy, 673
Plasmodium malariæ, 320
Plasters in eczema, 1051
Plethora, definition of, 375
Pleura, thickening of, in fibroid phthisis, 936
tuberculosis of, 122
Pleurisy, 907
complicating croupous pneumonia, 889
complications of, 917
diagnosis of, 915
etiology of, 909
following broncho-pneumonia, 880
frequency of, 907
gangrenous, 893
in erysipelas, 246, 249
in rheumatism, 369
in variola, 187
pathology of, 907
physical signs of, 913
prognosis of, 917
symptoms of, 912
treatment of, 918
tubercular, pathology of, 908
with effusion, 907
Pleuritis necessitatis, 908
Pleurosthotonos in cerebro-spinal meningitis, 232
Plox scindens, 158
Pneumatic speculum in chronic tympanic catarrh, 1119
Pneumococcus in exudate of simple meningitis, 613
of Fränkel in broncho-pneumonia, 876
in croupous pneumonia, 885
Pneumonia, catarrhal. See *Broncho-pneumonia.*
in measles, 147
chronic. See *Phthisis, fibroid.*
following broncho-pneumonia, 879
complicated by parotitis, 198
with pleurisy, incomplete crisis in, 916
croupous, 885
complications and sequels of, 889
diagnosis of, 889
from broncho-pneumonia, 889
from pleurisy with effusion, 889
etiology of, 885
in pertussis, 208
morbid anatomy of, 886
physical signs of, 888
prognosis of, 890
symptoms of, 886
treatment of, 890
varieties of, 888
embolic, in rheumatism, 369
fibrinous. See *Pneumonia, croupous.*
following asphyxia, 80
in diabetics, 972
in etiology of fibroid phthisis, 935
of pericarditis, 947
infective interstitial, in erysipelas, 246
in rheumatism, 369
in septic infection, 89
inspiration, 76, 91
lobar. See *Pneumonia, croupous.*
lobular. See *Broncho-pneumonia.*
migrans, 888
mode of drinking in, 6
septic, in scarlet fever, 166
staphylococci in, 74
with parotitis, 199
Pneumothorax complicating broncho-pneumonia, 880
Pointing of perinephritic abscess, 1005
Poisoning by carbon dioxide, 55
Poliomyelitis, acute anterior, 789
diagnosis of, 793
from cerebral palsy, 793
from diphtheritic palsy, 793
etiology of, 789

Poliomyelitis, acute anterior, morbid anatomy of, 789
pathology of, 790
prognosis of, 793
symptoms of, 790
treatment of, 794
subacute and chronic anterior, 795
diagnosis of, 796
from neuritis, 796
treatment of, 797
Politzer bag in middle-ear inflammation, 1112
inflation in chronic tympanic catarrh, 1119
in suppurating middle ear, 1114
Poluboskos in diabetes, 974
Polyadenitis, diagnosis of, from Hodgkin's disease, 107
from syphilis, 107
tuberculous, 107
after infectious diseases, 107
Polymyoclonus, post-hemiplegic, 654
Polyp masses in chronic suppurating middle ear, 1115
umbilical, 86
Polypus of rectum, 608
Polyuria in diabetes insipidus, 977
in etiology of constipation, 513
Pomegranate against tæniæ, 552
Porencephaly, 651
Post-natal atelectasis, 871. See *Atelectasis, post-natal.*
Posture in infancy, 12
in perinephritic abscess, 1005
Postures in rising in pseudo-hypertrophic paralysis, 770
Potassium acetate in ascites, 589
in rheumatism, 373
bromide in chorea, 763
in diabetes insipidus, 978
in eclampsia, 746
in epidemic cerebro-spinal meningitis, 235
in erysipelas, 251
in infancy, 36
in pertussis, 211
in scarlet fever, 170
in tubercular meningitis, 630
in variola, 189
carbonate in treatment of stone, 1017
chlorate as a cause of hæmaturia, 964
in acute pharyngitis, 432
in diphtheria, 284
in diseases of the mouth, 413
Potassium chlorate in mercurial stomatitis, 425
in stomatitis ulcerosa, 420
citrate in measles, 152
iodide in acute myelitis, 787
in asthma, 933
in brain tumors, 646
in broncho-adenitis, 903
in cerebral meningitis, 619
in cerebro-spinal meningitis, 235
in chronic interstitial nephritis, 998
in cirrhosis of liver, 575
in epilepsy, 752
in fibroid phthisis, 939
in interstitial keratitis, 1141
in pulmonary emphysema, 926
in syphiloderma, 1090
in tubercular meningitis, 630
salts in acute tubal nephritis, 989
Poultices forbidden in conjunctivitis, 1129
in bronchitis, 905
in pericarditis, 948
in peritonitis, 582
in peritonsillar abscess, 438
Pouting perforation of drum-membrane, significance of, in suppurating middle ear, 1114
Powder-burns of eyelid, 1128
Powders in eczema, 1050
Præcordial distress, 960
pain, 960
Predigested food in acute intestinal indigestion, 481
in mucous disease, 474
Predigestion, chemistry of, 47
Predisposition in etiology of diphtheria, 274
Prepuce, adherent, 1029
treatment of, 1030
traction upon, in gravel, 980
Preputial adhesions, spontaneous separation of, 1029
Presystolic mitral murmur, comparative frequency of, 954
murmur in mitral stenosis, 954
Priapism in acute myelitis, 784
in adherent prepuce, 1029
Prickly heat, 1038. See *Miliaria.*
Primary pleurisy, etiology of, 909, 912
Prince's staphylorraphy-needle, 452
Proctitis, 603
acute catarrhal, 604
chronic catarrhal, 604
Proctodæum, 593
Procursive epilepsy, 751
Profound sleep in etiology of incontinence of urine, 968
Prolapsus ani in chronic intestinal indigestion, 485
of rectum, 606
in pertussis, 208
Proliferation, zone of, in rachitic bone, 345
Prophylaxis of septic infection, 89
Prostate gland in children, 1017
Prostration in cholera, 259
in variola, 184
Proteid poisons from toxicogenic germs, 490
Prurigo, 1067
Pruritus ani, 600
genital, in diabetes mellitus, 972
in vaccinia, 194
Pseudo-croup, 848
Pseudo-diphtheria, 434. See *Tonsillitis, infectious pseudo-membranous.*
in variola, 187
Pseudo-hypertrophic muscular paralysis, 768
diagnosis of, 773
from congenital spastic paraplegia, 773
from progressive chronic neuritis, 773
etiology of, 771
morbid anatomy of, 772
treatment of, 773
Pseudo-membrane of diphtheria, 276
of pharynx in variola, 185
Pseudo-membranes, streptococci in, 273
varieties of, 272
Psoriasis, 1055
circinata, 1056
diagnosis of, 1056
from scaling syphilides, 1057
from scaly eczema, 1056
from seborrhœa, 1056
diffusa, 1056
etiology of, 1056
guttata, 1056
gyrata, 1056
nummularis, 1056
prognosis of, 1057
punctata, 1056
treatment of, 1057
varieties of, 1056
"Psychical equivalent" of hysteria, 736
Ptomaïnes in scarlatinal nephritis, 164
in septic infection, 89
Ptosis, 1126
Ptyalin, scarcity of, in infants, 45

Pubic louse in eyebrows or lashes, 1100
Puerile respiration, 16
Pulmonary artery, stenosis of, 942
emphysema, 922
orifice and artery, atresia of, 943
resonance, alterations of, 17
at bases, 17
in infrascapular regions, 17
in interscapular space, 17
in scapular region, 17
tuberculosis. See *Tuberculosis, pulmonary.*
Pulsating pleurisy, 917
Pulse, 10
diminished frequency of, 11
in jaundice, 11
in nephritis, 11
importance of, in diagnosis, 11
in acute milk infection, 492
in acute spinal leptomeningitis, 780
in acute tubal nephritis, 983
in asthma, 930
in bronchitis, 900
in broncho-pneumonia, 878
in catarrhal dysentery, 504
in cerebral meningitis, 615
in cerebro-spinal meningitis, 233
in childhood, character of, 11
in chlorosis, 379
in cholera, 260
in chronic tubal nephritis, 991
increased frequency of, 11
in croupous pneumonia, 887
in diphtheria, 278
in erysipelas, 247
in gangrene of lung, 894
in influenza, 238
in invasion of variola, 184
in jaundice, 559
in leukæmia, 390
in measles, 144, 145
in pericarditis, 947
in peritonitis, 581
in pernicious anæmia, 382
in pleurisy, 912, 913
in post-natal atelectasis, 872
in rachitis, 355
in scarlet fever, 160
in simple cerebro-spinal meningitis, 623
in stomatitis gangrenosa, 422
in subacute purpura hæmorrhagica, 397
in tubercular meningitis, 628
in typhoid fever, 222
palpation of, in infants, 11
relation of, to fever, 11
Pulsus paradoxus, 959
Pumpkin-seed against tæniæ, 553
Pupil, alterations of, with tumors of spinal cord, 804
in cerebro-spinal meningitis, 232
in simple cerebro-spinal meningitis, 622
in uræmia, 983
Pupillary symptoms in hereditary ataxia, 818
in syringomyelia, 813
Pupils in cerebral meningitis, 615
in coma of pernicious malaria, 330
Purgation in cerebral meningitis, 619
in cerebro-spinal meningitis, 624
Purgatives in typhlitis and appendicitis, 529
Purpura, 1069
after influenza, 240
diagnosis of, 1071
from flea-bite, 1071
from scurvy, 1071
etiology of, 1071
hæmorrhagica, 395, 1070
acute, 400
cases complicating pregnancy, 402
cases with marked sepsis, 401
cases with visceral hæmorrhages, 402
essential, 395
ordinary cases of, 396
secondary, 403
after fright, etc., 404
in non-syphilitic infants, 404
in syphilitic infants, 404
with anæmia, etc., 404
with cases of severe jaundice, 404
with infectious diseases, 404
with malignant endocarditis, 404
with multiple sarcomata, 404
subacute, 396
constitutional symptoms of, 396
hæmorrhagic symptoms of, 396
pathology of, 397
prognosis of, 398
treatment of, 398
neonatorum, 1070
prognosis of, 1071
rheumatica, 403, 1070
simplex, 403
treatment of, 1071
Purulent corneal ulcer, 1138
iritis, 1142
pleurisy, 907
Pustular syphiloderm, 1088
Pustule of hæmorrhagic variola, 183
Pustule of variola, 183
Putty stools, 484
Pyer's patches in cholera, 258
Pyonephrosis, 1003
diagnosis of, 1004
etiology and pathology of, 1003
prognosis of, 1004
treatment of, 1004
tubercular, 122
Pyopneumothorax, 917
Pyrexia, types of, 12
Pyrogallic acid in lupus vulgaris, 1085
Pyromania, 703
Pyrophobia, 704
Pyuria, 967
in stone in bladder, 981

Q.

Quarantine in measles, 154
Quartan malarial fever, characteristics of, 328
parasite of, 322
differences of, from tertian, 322
Questioning the attendants, definite order in, 2
Quinine and urea, muriate of, in malaria, 333
in acute endocarditis, 952
in acute middle-ear inflammation, 1113
in amœbic dysentery, 511
in asthma, 934
in broncho-pneumonia, 883
in croupous pneumonia, 890
in eczema, 1049
in malarial fever, 333
in malignant measles, 152
in measles, 152
in pertussis, 211
in Raynaud's disease, 825
in rheumatism, 373
in scarlet fever, 170
in tubercular meningitis, 630
in tuberculosis, 126
in typhoid fever, 226
in variola, 189, 190
locally in pertussis, 212
Quinsy. See *Peritonsillar abscess.*
Quotidian intermittent fever, diagnosis of, 331
temperature in, 327

R.

Race in etiology of vesical calculus, 1012
Rachitic bone, analyses of, 346
child, characters of, 347
deformities of pelvis, 352
fœtus, 346
head, description of, 348
paralysis, 358
pseudo-cretinism, 684

Rachitic rosary, diagnostic value of, 338
Rachitis, 335. See, also, *Rickets.*
age of occurrence of, 338
among the well-to-do, 336
anatomical characters in stage of deformity of, 346
in stage of proliferation of, 344
in stage of reconstruction of, 354
changes in osseous system in, 343
in soft tissues in, 341
of cranial bones in, 347
definition of, 335
diagnosis of, 336
dietetic causes of, 341
due to proprietary foods, 339
etiology of, 339
fœtal, 338
frequency of, 335
among Italians and negroes, 336
general symptoms of, 354
hygienic treatment of, 358
pathology of, 341
treatment of, 358
Radius, changes in, in rachitis, 352
Râles in asthma, 931
in bronchitis, 902
in broncho-pneumonia, 880
in pleurisy, 914
in pneumonia, 888
in pulmonary tuberculosis, 120
Rapid heart, 960
with tumors of spinal cord, 804
Rash. See, also, *Eruption.*
in malignant measles, 147
Rashes. See, also, *Eruptions.*
in chronic gastric catarrh, 464
initial, in variola, 184
Raspberry excrescence, 194
Raynaud's disease, 820
course, duration, results of, 824
diagnosis of, 824
etiology of, 822
pathology of, 823
relation of intermittent hæmoglobinuria to, 823
treatment of, 824
Reaction of degeneration in acute poliomyelitis, 791
Reactions, electrical, in acute poliomyelitis, 791
in pseudo-hypertrophic paralysis, 771
Rectum, absence of, 599
congenital narrowing of, 594
diseases of, 600
foreign bodies in, 611
imperforate, 594
Rectum, imperforate, perineal operation for, 595
malignant disease of, 610
nævus of, 609
polypus of, 608
treatment of, 609
prolapsus of, 606
diagnosis of, 607
treatment of, 607
varieties of, 606
with seat-worms, 546
stricture of, 605
syphilis of, 605
ulceration of, 605
wounds of, 610
Recurrence after nephrectomy for tumors of kidney, 1009
after operations for stone, 1019
in endocarditis, 950
of paroxysms of spasmodic laryngitis, 849
Recurrent attacks in purpura hæmorrhagica, 397
headache, 721
"Red softening," 632
Reduplication of second sound at apex in endocarditis. 951
Reflex headache, 723
insanities, 706
irritation of anus in chronic gastric catarrh, 465
of nostrils in chronic gastric catarrh, 465
pains in vesical calculus, 1015
symptoms from cerumen impaction, 1106
Reflexes in acute myelitis, 784
in acute poliomyelitis, 791
in athetosis, 695
in hereditary ataxia, 817
in infantile cerebral palsies, 654
with tumors of spinal cord, 803
Refraction of eye in childhood, 1145
Regurgitation, aortic, 955
mitral, 953
tricuspid, 955
Relapses in subacute milk infection, 498
in typhoid fever, 223
Remittent fevers, irregular, 328
Renal cirrhosis. See *Nephritis, chronic interstitial.*
cysts, 999
insufficiency in chronic heart disease, treatment of, 957
sclerosis. See *Nephritis, chronic interstitial.*
Resection of rib in empyema, 919
Resonance of chest, different degrees of, 16
percussion, in health, 16
pulmonary, alteration of, 17
at bases, 17
in infrascapular regions, 17
in interscapular space, 17
in scapular region, 17
Resorcin in erysipelas, 251
in mucous disease, 475
in pertussis, 212
Respiration, 10
accelerated, causes of, 10
arrest of, during tracheotomy, 301
artificial, Duke's method, 79
Forest's method, 79
Hall's method, 79
Reynolds's method, 79
Schultze's method, 78
Sylvester's method, 79
Cheyne-Stokes, 10
diminished frequency of, 10
expiratory, 10
in ascites, 15
in asthma, 930
in bronchitis, 900
in cerebral meningitis, 615
increase in rapidity of, 10
in enteritis, 15
in infancy, 16
in malignant measles, 147
in measles, 146
in peritonitis, 15, 581
in pleurisy and pneumonia, 15
in post-natal atelectasis, 873
in rachitis, 15
in severe spasmodic laryngitis, 852
in tubercular meningitis, 620
in variola, 184
irregularity of, 10
in children, 959
mode of estimating, 10
puerile, 16
rapid, in hysteria, 735
rates of, during sleep, 10
in children, 10
type of, in children, 10
Rest in chronic tubal nephritis, 994
in typhoid fever, 225
Results of corneal ulceration, treatment of, 1140
Retention of clots in hæmaturia, 963
Retraction of chest-wall in atelectasis, 873
Retractors in tracheotomy, caution in use of, 298
Retro-pharyngeal abscess, 443
treatment of, 444
lymphadenitis, 443
tracheotomy in, 456
Reynolds's method of artificial respiration, 79

Rhabdis genitalis a cause of hæmaturia, 965
Rhabdo-sarcoma of kidney, 1007
Rhagades in hereditary syphilis, 134
syphilitic, characteristics of, 424
Rheumatic diathesis in etiology of acute gastric catarrh, 457
Rheumatism, 367
acute, 367
course and duration of, 371
cutaneous eruptions in, 370
definition of, 367
diagnosis of, 370
from cerebro-spinal fever, 371
from pyæmia, 371
from rickets, 371
from scarlatinal rheumatism, 370
from scurvy, 371
from syphilis, 371
etiology of, 367
prognosis of, 371
treatment of, 372
after influenza, 239
chronic, 374
diagnosis of, from rheumatoid arthritis, 374
treatment of, 374
in etiology of acute endocarditis, 949
of pericarditis, 947
of psoriasis, 1056
of vesical calculus, 1011
local treatment of, 373
morbid anatomy of, 368
muscular, 373
diagnosis of, 374
from neuralgia, 374
prognosis of, 374
treatment of, 374
with peritonitis, 580
Rhinitis, acute, 826
treatment of, 827
atrophic, 833
diagnosis of, 835
from hereditary syphilis, 835
treatment of, 836
hypertrophic, 829
diagnosis of, 831
pathology of, 829
treatment of, 832
purulent, 828
treatment of, 829
simple chronic, 828
diagnosis of, 828
Ribs, changes in, in rachitis, 350
Rickets. See *Rachitis.*
acute, 358
in the etiology of eclampsia, 742
Rickets in the etiology of laryngismus stridulus, 858
of splenic anæmia, 384
predisposing to scorbutus, 405
Rigidity and contractures in infantile cerebral palsies, 654
in acute spinal leptomeningitis, 779
in simple cerebro-spinal meningitis, 622
Rigors. See *Chills.*
Ringworm. See *Tinea trichophytina.*
Romanowsky's method of staining in malaria, 332
Rosanilin hydrochlorate in tinea tonsurans, 1097
Rose spots in typhoid fever, 220
Roseola, epidemic. See *Rubella.*
infantilis, 1041
Rötheln. See *Rubella.*
Round-worm. See *Ascaris lumbricoides.*
Rubella, 176
definition of, 176
diagnosis of, 177
from measles, 177
from scarlet fever, 177
distinction of, from measles, 176
incubation of, 176
in etiology of bronchitis, 896
synonyms of, 178
treatment of, 178
Rupture in hydatid of liver, 572

S.

Saccharin in diabetic diet, 975
Saccharomyces albicans, 417
biology of, 417
Saemisch's section, 1139
Salicin in rheumatism, 373
in scarlatinal arthritis, 170
Salicylates in rheumatic tonsillitis, 373
value of, in rheumatism, 372
Salicylic acid in rheumatism, 372
in treatment of warts, 1075
in tuberculosis, 126
Salicylic-creasote plaster-mull in lupus, 1085
Salines in dysentery, 509
in peritonitis, 583
Salivation in stomatitis ulcerosa, 420
Salol in cholera, 266
in chronic gastric catarrh, 467
in gonorrhœa, 1026
in jaundice, 565
in mucous disease, 475
Salol in parotitis, 200
in typhoid fever, 227
in vulvo-vaginitis, 1028
Salophen in chorea, 762
Santonin against ascarides, 544
against seat-worms, 547
Sarcoma of eyelids, 1125
of kidney, 1007
of orbit, 1145
of peritoneum, 586
Sarcomata of brain and meninges, 637
Satyriasis, 703
Scabies, 1098
diagnosis of, from eczema, 1099
etiology of, 1099
prognosis of, 1099
treatment of, 1099
Scalp, eczema of, treatment of, 1053
Scaphocephalic idiocy, 673
Scarification in treating erysipelas, 251
Scarlatina. See *Scarlet fever.*
fulminans, 161
intermittens, 163
miliaria, 163
papulosa, 162
pemphigoides seu bullosa, 163
petechialis seu hæmorrhagica, 163
simplex, 161
sine angina, 161
with pertussis, 208
Scarlatinal nephritis, 164
diagnosis of, from septic, 166
heart-failure in, 172
prognosis of, 168
treatment of, 171
Scarlet fever, 155. See, also, *Scarlatina.*
association of, with varicella, 155
bacteriology of, 157
complications of, 163
contagion after disinfection in, 157
by fomites, 157
by milk, 157
contagiousness of, 155
contagium of, 156
danger in light cases of, 168
day of maximum temperature in, 161
definition of, 154
diagnosis of, 167
from erythema scarlatiniforme, 167
from measles, 168
from rubella, 168
disinfection of bedding after, 175
of room after, 171
endocarditis with, 950
etiology of, 155

Scarlet fever, examination of urine in, 171
history of, 155
incubation of, 160
in etiology of chronic tubal nephritis, 990
of pericarditis, 947
microbic origin of, 156
mode of transmission of, 157
mortality of, 169
pathology of, 159
prognosis of, 168
prophylaxis of, 173
failure of drugs in, 173
quarantine in, 173
sequelæ of, 166
symptoms of, 160
treatment of, 169
value of isolation in, 173
varieties of, 163
Schools, physical culture in, 54
Schultze's method of artificial respiration, 78
Sclerema neonatorum, 1076
diagnosis of, 1076
from œdema, 1076
etiology of, 1076
prognosis of, 1076
treatment of, 1076
Scleroderma, 1077
diagnosis of, 1077
from Kaposi's disease, 1078
from sclerema neonatorum, 1077
etiology of, 1077
prognosis of, 1078
treatment of, 1078
Sclerosis, lateral, with syringomyelia, 813
of Ammon's horn in epilepsy, 748
of tubercle, 102
Scoliosis, 350
causes of, 54
in syringomyelia, 813
treatment of, 54
Scorbutus, 405
diagnosis of, 410
etiology of, 405
morbid anatomy of, 406
prognosis of, 410
treatment of, 410
Scrofula, relation of, to tuberculosis, 101
Scrofuloderma, 1086
diagnosis of, 1087
etiology of, 1086
treatment of, 1087
Scrofulous diathesis, 100
in etiology of acute gastric catarrh, 458
iritis, 1142
kidney, 122
Scurvy, 405. See *Scorbutus.*
as a cause of hæmaturia, 966
Scutulum of favus, 1092
Sea-air, 60
in asthma, 63
in chorea, 64
in convalescence, 62
from measles, 151
in diseases of the eye, 65
in entero-colitis, 62
in nasal catarrh, 63
in pharyngeal catarrh, 63
in phthisis, 63
in Pott's disease, 64
in rheumatism, 64
in rickets, 64
in whooping-cough, 65
odor of, 60
ozone in, 60
sodium chloride in, 60
Sea-bathing, 65
effects of, 66
frequency of, 66
hour for, 66
rules for, 66
season for, 66
value of, 65
Sea-coast, clothing at, 67
death-rate at, 61
exercise at, 67
food at, 67
rainfall at, 62
temperature at, 61
wind at, 62
Season in etiology of chorea, 756
of erysipelas, 243
of malaria, 320
of measles, 142
of variola, 183
of whooping-cough, 202
Seat-worm. See *Oxyuris vermicularis.*
Sea-water, composition of, 65
Sebaceous cyst of eyelid, 1127
Seborrhœa, 1035
diagnosis of, 1035
from eczema, 1035
from psoriasis, 1035
etiology of, 1035
of lid-border. See *Blepharitis.*
prognosis of, 1036
treatment of, 1036
Second attacks of whooping-cough, 202
Sedentary habits in etiology of constipation, 513
life in etiology of constipation, 513
Sediment in urine of acute tubal nephritis, 984
Segmentation of malarial organisms, 322
relation of, to paroxysm, 322
Sensory symptoms of syringomyelia, 812
Septal deflection in adenoid hypertrophy, 447
Septic diseases in etiology of acute tubal nephritis, 983
Septic infection of new-born, 89
prophylaxis of, 89
treatment of, 89
Septicæmia in etiology of bronchitis, 897
in scarlet fever, 166
Septico-pyæmia of new-born, pleurisy in, 910
Serous cystic tumors of peritoneum, 586
exudate in peritonitis, 581
irido-cyclitis, 1142
iritis, 1142
Serpiginous corneal ulcer, 1138
Serum treatment of croupous pneumonia, 890
Sex in etiology of chlorosis, 378
of chorea, 756
of chronic peritonitis, 584
of cirrhosis of the liver, 574
of diabetes mellitus, 971
of intussusception, 534
of laryngismus stridulus, 858
of rheumatism, 367
of simple meningitis, 612
of typhlitis, 526
of vesical calculus, 1012
of whooping-cough, 203
in prognosis of pertussis, 209
Sexual organs in idiocy, 677
power in hereditary ataxia, 817
Shell-fish in diabetic diet, 975
Shingles. See *Herpes zoster.*
Shoes for children, 34
Signe de Dance, 535
Silver nitrate in jaundice, 564
in ophthalmia neonatorum, 1131
in stomatitis aphthosa, 416
in stomatitis catarrhalis, 414
in stomatitis syphilitica, 425
Simple atrophy. See *Atrophy, simple.*
corneal ulcer, 1138
Sinapisms in Landry's paralysis, 799
Siphonage in empyema, 920
of chest, details of operation, 921
Size, average, of new-born child, 12
Skeleton, effect of rachitis upon, 353
Skin, appearance of, in disease, 5
in health, 5
atrophies of, 1079
condition of, in health, 13
in intestinal tuberculosis, 13
in marasmus, 13
in mucous disease, 13

Skin, condition of, in protracted diarrhœa, 13
diseases of, 1034
hæmorrhages of, 1069
hypertrophies of, 1072
in acute poliomyelitis, 792
in post-natal atelectasis, 872
in scarlet fever, 160
in simple atrophy, 521
new growths of, 1081
parasitic affections of, 1092
Skoda's resonance, 120
Skull, depressions in, 83
Sleep, 34
amount required, 34
in chronic gastric catarrh, 465
regularity in, 34
temperature of room for, 35
"Sleeping cool," 4
"Sleeping high," 4
Sloughing corneal ulcer, 1138
Slow heart, 960
pulse in acute gastric catarrh, 460
in diphtheria, 278
Small-pox. See *Variola.*
Soap plaster, Hardaway's modification of Pick's, 1052
Pick's, in eczema, 1052
Soda solution, Parker's, 302
Sodium bicarbonate in chronic gastric catarrh, 467
in rheumatism, 373
in stomatitis mycosa, 418
bromide in chronic heart disease, 957
in uræmic convulsions, 988
ethylate for nævus vascularis, 1083
hypophosphite in furunculus, 1068
phosphate in cirrhosis of liver, 576
in congestion of liver, 567
in constipation, 515
in jaundice, 564
salicylate in acute follicular tonsillitis, 436
in chorea, 762
in diabetes mellitus, 976
in peritonsillar abscess, 437
in rheumatism, 372
Softening of tubercle, 102
Solution, Gabbet-Ernst's, 95
of fuchsin, Ziehl's, 95
Somnambulism, 732
Somnial epilepsy, 751
Sore throat. See *Angina.*
Soups in diabetic diet, 975
Soya flour in diabetes, 974
Sparteine in atelectasis, 875
in peritonitis, 583
Spasm in laryngismus stridulus, 861
inward, 744
Spasmodic laryngitis, severe form, 852
Spasmus glottidis. See *Laryngismus stridulus.*
Specific fevers in etiology of acute gastric catarrh, 458
Spectacles in treatment of concomitant convergent strabismus, 1147
Speech, affections of, due to peripheral paralysis, 666
bad habits of, 667
defects and anomalies of, 660
from adenoid growths, 667
treatment of, 667
in cretinism, 684
in hereditary ataxia, 818
in idiocy, 677
Sphincter ani, paralysis of, with tumors of spinal cord, 804
Spigelia against ascarides, 545
against seat-worms, 547
Spinal cord, tumors of, 801
tenderness in acute leptomeningitis, 779
Spirillum choleræ Asiaticæ, 254
bacteriology of, 254
modes of multiplication of, 254
multiplication of, in culture-media, 255
poison elaborated by, 257
Spleen, chronic diffuse tuberculosis of, 106
enlargement of, diagnosis of, 14
in malarial cachexia, 330
in rachitis, 342
in diphtheria, 276
in leukæmia, 390
in pernicious malaria, 325
in splenic anæmia, 384
in typhoid fever, 221
superior border of, 17
syphilis of, 129
Splenectomy in leukæmia, 392
Sporadic cerebro-spinal meningitis. See *Meningitis, simple cerebro-spinal.*
Spraying in diphtheria, 286
Sprays in hypertrophic rhinitis, 832
Squamous blepharitis. See *Blepharitis.*
Squills in broncho-pneumonia, 883
in severe spasmodic laryngitis, 854
Squint. See *Strabismus.*
Stacke operation in chronic suppurating middle ear, 1116
Stammering, 666
Staphylococci in croupous pneumonia, 886
Staphylococcus albus in acute follicular tonsillitis, 434
in broncho-pneumonia, 876
in peritonitis, 580
pyogenes aureus in acute follicular tonsillitis, 434
Staphyloma of cornea, 1139
treatment of, 1140
Staphylorraphy, 452
conditions for success in, 452
Starch, digestion of, 45
diastase in, 45
fermentation of, 22
Starvation, partial, in treatment of tæniæ, 552
Statistics in appendicitis, 532
of operations for stone, 1019
of tracheotomy, 293
Status eclampticus, 744
epilepticus, 751
Stenosis, aortic, 954
mitral, 954
of aorta, 944
of conus arteriosus, 943
of pulmonary artery, 942
causes of, 943
symptoms of, 943
Sterilization, 47
apparatus for, 26
at low temperature, 48
method of, 27
of milk, 26
advantages of, 48
disadvantages of, 48
Sterilized milk, character of, 27
Stigmata degenerationis, 656
in cirrhosis of liver, 574
of epilepsy, 751
of hysteria, 732
Stimulants. See *Alcohol.*
in acute milk infection, 494
in cerebral meningitis, 620
in croupous pneumonia, 890
in dysentery, 509
in erysipelas, 251
in post-natal atelectasis, 875
"Stomach cough" in chronic gastric catarrh, 465
Stomach-washing in acute milk infection, 493
Stomatitis aphthosa, 415
etiology of, 415
prognosis of, 416
treatment of, 416
catarrhalis, 413
erythematous form of, 413
etiology of, 413
in pertussis and acute exanthemata, 414
in teething, 428
prognosis of, 414
treatment of, 414
crouposa, 423
diphtheritica, 423

Stomatitis diphtheritica, diagnosis of, 424
primary, in mouth, 424
prognosis of, 424
treatment of, 424
follicular, in chronic intestinal indigestion, 484
gangrenosa, 421
etiology of, 421
pathology of, 421
prognosis of, 423
treatment of, 423
in subacute milk infection, 497
mycosa, 416
etiology of, 417
in chronic gastric catarrh, 464
pathology of, 417
prognosis of, 423
treatment of, 418
syphilitica, 424
treatment of, 425
ulcerosa, 418
chronic, 420
etiology of, 418
pathology of, 419
prognosis of, 420
treatment of, 420
Stomodæum, 593
Stone in bladder, symptoms of, 980
Stools in acute intestinal indigestion, 482
in acute milk infection, 492
in amœbic dysentery, 507
in catarrhal dysentery, 504
in cholera, 259
in chronic intestinal indigestion, 484
in simple atrophy, 521
in subacute milk infection, 495
Strabismus, 1146
after acute illnesses, 1147
concomitant convergent, 1146
causes of, 1147
diagnosis of, from paralytic, 1147
treatment of, 1147
convergent, 1146
divergent, 1146
in cerebral meningitis, 615
in cerebro-spinal meningitis, 232
in idiocy, 676
in simple cerebro-spinal meningitis, 622
paralytic convergent, 1146
upward or downward, 1146
Stramonium in asthma, 933
Strangulation, internal, by appendix, 532
Streptococci associated with bacillus of diphtheria, 274
in septic infection of newborn, 89
Streptococcus erysipelatis, 245
in acute folliculous tonsillitis, 434
infection by, in pustules of variola, 187
in peritonitis, 580
in pseudo-membrane of variola, 185
invasion of, in variola, 187
lanceolatus in pleurisy, 911
pyogenes aureus in pleurisy, 911
in acute folliculous tonsillitis, 434
in broncho-pneumonia, 876
in croupous pneumonia, 886
in pleurisy, 911
Stricture of anus, 603
of rectum, 605
"Strippings," 25
value of, 38
Strontium lactate in chronic interstitial nephritis, 998
Strophanthus in atelectasis, 875
in chronic tubal nephritis, 995
in peritonitis, 583
Strophulus albidus. See *Milium.*
in simple atrophy, 521
Strumous keratitis and conjunctivitis. See *Keratoconjunctivitis, phlyctenular.*
Strychnine in acute poliomyelitis, 795
in asphyxia of new-born, 80
in asthma, 934
in broncho-pneumonia, 883
in chronic heart disease, 957
in croupous pneumonia, 890
in diphtheria, 283
in diphtheritic paralysis, 289
in incontinence of urine, 969
in pulmonary emphysema, 926
in variola, 190
Stupes in peritonitis, 582
Stupor in invasion of variola, 184
Stuttering, 666
Stye. See *Hordeolum.*
Subcutaneous nodes in chorea, 755
Subsultus tendinum in cerebro-spinal meningitis, 232
Succussion sound in pyopneumothorax, 917
Sucrose, 46
Suction, act of, significance of its diminution, 6
significance of its re-establishment, 6
Sugar in urine in simple atrophy, 522
tests for, in diabetic urine, 972
Sugars, digestion of, 45
Suggestion in hysteria, 740
Sulphonal in diabetes mellitus, 976
in variola, 189
Sulphur in scabies, 1099
in pertussis, 213
Sulphuric acid in cholera, 266
in night-sweats, 126
Sulphur-vapor after diphtheria, 283
Summer diarrhœa. See *Milk infection, subacute.*
Superficial cervical fascia, 292
Suppositories in constipation, 515
in prolapse of rectum, 607
Suppuration, chronic, in etiology of chronic tubal nephritis, 990
fever of, in variola, 185
in etiology of amyloid kidney, 996
in hydatid of liver, 572
in typhlitis, 527
Suppurative pleurisy, 907
Supraglottic laryngitis. See *Laryngitis catarrhalis simplex.*
Suprapubic lithotomy, 1019
Surf-bathing in etiology of middle-ear inflammation, 1110
Surgical treatment in infantile cerebral palsies, 659
of brain tumors, 646
of epilepsy, 753
Sweating in gangrene of lung, 893
in pulmonary tuberculosis, 120
Sweats in rheumatism, 368
Sylvester's method of artificial respiration, 79
Symblepharon, 1126
treatment of, 1126
Sympathetic irritation, 1143
ophthalmitis, 1143
Syncope, 960
in secondary anæmia, 377
local, 821
Synechia, anterior, 1139
Synechiæ, posterior, 1142
Syphilide, papular, of eyelid, 1124
Syphilis, acquired, 127
after vaccination, 195
as a cause of rickets, 339
hæmorrhagica neonatorum, 134
hereditary, 127
alopecia in, 136
blood in, 134
bone-lesions in, 130

Syphilis, hereditary, bone-lesions in, diagnosis of, from rickets, 137
from tubercular, 137
conceptional, 127
coryza in, 133
definition of, 127
diagnosis of, 136
from scrofula, 136
disturbance of nutrition in, 134
glandular enlargements in, 134
in etiology of splenic anæmia, 384
in infancy, 127
involvement of bones in, 135
lesions of heart in, 130
of kidneys in, 130
of liver in, 130
of lungs in, 129
of mucous membranes in, 129, 133
of pancreas in, 130
of spleen in, 130
of testicles in, 130
maternal influence in, 128
morbid anatomy of, 129
mucous patches in, 134
myositis in, 135
nervous disturbances in, 135
of nose and throat, 842
paternal influence in, 127
placenta in, 129
prognosis of, 137
rashes of, 133
skin symptoms of, 133
symptoms of, 132
teeth in, 135
treatment of, 139
visceral lesions of, 129
in etiology of acquired labyrinthine deafness, 1120
of amyloid kidney, 996
of cirrhosis of liver, 574
of leukæmia, 389
of lymphatic anæmia, 386
of paroxysmal hæmaturia, 966
inherited, nervous affections due to, 647
late hereditary, 138
bone-affections in, 138
genital organs in, 139
interstitial keratitis in, 139
nephritis in, 139
periostitis in, 138
teeth in, 138
of eyelids, 1124
of rectum, 605
primary lesions of, in mouth, 424
pulmonary, causative of asphyxia, 77
secondary lesions of, in mouth, 424
Syphilis, skin-lesions of, 129
tarda. See *Syphilis, late hereditary.*
Syphilitic asthma, 926
headache, 722
lesions of auricle, 1104
Syphilization, double, 128
Syphiloderma, 1087
diagnosis of, 1089
bullous from pemphigus neonatorum, 1089
erythematous from intertrigo, 1089
etiology of, 1089
prognosis of, 1089
treatment of, 1089
Syringing in cerumen impaction, 1106
in extracting foreign bodies from auditory canal, 1108
Syringomyelia, 809
diagnosis of, 814
etiology of, 809
morbid anatomy of, 810
pathology of, 810
symptoms of, 812
treatment of, 814
Systolic mitral murmur, relative frequency of, 954
murmur in aortic stenosis, 954
in defect of ventricular septum, 941
in mitral regurgitation, 953

T.

Tabes mesenterica, 110
Tache cérébrale in cerebral meningitis, 615
Tachycardia, 960
Tænia, 548
cucumerina, 550
mediocanellata, 549
nana, 550
solium, 549
Tæniæ, diagnosis of, 551
habitat of, 550
method of infection by, 550
ova of, 550
treatment of, 551
varieties of, 549
Talipes equinus in pseudo-hypertrophic paralysis, 771
Tannin in gastro-intestinal hæmorrhage, 87
Tapeworm. See *Tænia.*
Tapotement, 57
Tar-and-zinc ointment in eczema of scalp, 1053
Tarsitis, 1125
Tarsorraphy for lagophthalmos, 1126
Tartar emetic in severe spasmodic laryngitis, 854
Tattooing in leucoderma, 1080
Taxis in intussusception, 537
Tears, significance of, in prognosis, 7
Teeth, eruption of, in etiology of eczema, 1047
milk, appearance of, 17
permanent, 17
order of appearance of, 427
premature, 427
time of eruption of, 427
Teething as an etiological factor, 425
order of, 426
symptoms of, 428
treatment of, 429
Temperature, 11
abnormal depression of, 12
during first week of life, 11
estimation of, 11
in acute gastric catarrh, 459
in acute intestinal indigestion, 482
in acute milk infection, 492
in acute myelitis, 784
in acute poliomyelitis, 790
in acute spinal meningitis, 780
in acute tubal nephritis, 983
in brain abscess, 633
in bronchitis, 900
in broncho-pneumonia, 878
in catarrhal dysentery, 504
in cerebral meningitis, 614
in cerebro-spinal meningitis, 233, 623
in chicken-pox, 181
in cholera, 260
in chronic intestinal indigestion, 484
in chronic peritonitis, 584
in cirrhosis of liver, 574
in croupous pneumonia, 886
in diphtheria, 278
in disease, 12
in epidemic cerebro-spinal meningitis, 233
in erysipelas, 247
in gangrene of lung, 893
in infectious pseudo-membranous tosillitis, 435
in influenza, 238, 239
in intussusception, 535
in Landry's paralysis, 799
in lymphatic anæmia, 387
in malignant measles, 147
in measles, 143, 145
in perinephritic abscess, 1005
in peritonitis, 581
in peritonsillar abscess, 437
in pleurisy, 912, 913
in post-natal atelectasis, 872
in rachitis, 355
in Raynaud's disease, 822
in rubella, 177
in scarlet fever, 161
in scorbutus, 407
in severe spasmodic laryngitis, 853

Temperature in simple atrophy, 521
in spasmodic laryngitis, 850
in stomatitis catarrhalis, 414
in stomatitis gangrenosa, 422
in subacute milk infection, 495
in subacute purpura hæmorrhagica, 396
in syphilitic inflammation of liver, 568
in tubercular meningitis, 628
in typhlitis, 527
in typhoid fever, 218
in vaccinia, 194
in variola, 184
after eruption, 185
in whooping-cough, 205
maximum of, 12
minimum of, 12
oscillations of, 11
in disease, 12
post-mortem rise of, in erysipelas, 245
post-typhoid elevation of, 223
variations in typical range of, 12
Temporal bone, necrosis of, in ear disease, 1117
Tenderness in intussusception, 535
in peritonitis, 581
in typhlitis, 526
of surface in rachitis, 365
in scorbutus, 467
Tendon-reflexes in pseudo-hypertrophic paralysis, 771
Tenesmus, hysterical, 735
in intussusception, 536
Tenotomy in infantile cerebral palsies, 659
Terebene in pulmonary emphysema, 927
in tuberculosis, 126
Terebinthine in tuberculosis, 125
Tertian intermittent fever, 326
chilly stage of, 326
diagnosis of, 331
fever stage of, 326
parasite of, 320
physical signs in, 328
sweating stage of, 327
temperature in, 326
Testicle, syphilis of, 130
tuberculosis of, 123
Tetanus of new-born, 91
treatment of, 91
Tetany, 764
diagnosis of, 766
from hysteria, 766
etiology of, 764
in rachitis, 357
morbid anatomy of, 766
prognosis of, 767
Tetany, relation of, to laryngismus stridulus, 858
symptoms of, 765
treatment of, 767
Thermo-cautery in stomatitis mycosa, 423
Thirst in acute milk infection, 492
in cholera, 259
in diabetes insipidus, 977
in diabetes mellitus, 971
in measles, 143
in rachitis, 355
in simple cerebro-spinal meningitis, 623
Thompson's mixture in rachitis, 365
Thomsen's disease. See *Myotonia.*
Thorax, deformity of, in rachitis, 350
with adenoid vegetations, 448
rachitic deformity of, 357
Thread-worm. See *Oxyuris vermicularis.*
Thrill in mitral stenosis, 954
Throat, treatment of, in scarlet fever, 170
Thrombosis in infantile cerebral palsies, 658
of dural sinuses in dysentery, 502
Thrush in chronic intestinal indigestion, 484
in simple atrophy, 521
Thymol in tuberculosis, 126
in typhoid fever, 227
Thymus gland, relations of, in tracheotomy, 292
Thyroid extract in cretinism, 686
gland, transplantation of, in cretinism, 686
Tibia, changes in, in rachitis, 353
Tinea circinata, 1095
diagnosis of, 1096
from psoriasis, 1096
from seborrhœa, 1096
from syphilis, 1096
treatment of, 1097
favosa, 1092
diagnosis of, 1093
etiology of, 1093
prognosis of, 1093
treatment of, 1094
tonsurans, 1095
diagnosis of, from alopecia areata, 1096
from eczema, 1096
from psoriasis, 1096
from seborrhœa, 1096
disseminata, 1096
treatment of, 1097
trichophytina, 1095
etiology of, 1096
prognosis of, 1096
treatment of, 1097
Tongue, appearance of, in health, 17
in acute gastric catarrh, 459
in catarrhal dysentery, 504
in fever, 17
in invasion of variola, 184
in malignant measles, 147
in measles, 144, 146
in peritonitis, 581
in post-natal atelectasis, 871
in rheumatism, 368
in scarlet fever, 161
in simple atrophy, 521
in stomatitis catarrhalis, 414
in stomatitis syphilitica, 425
in typhlitis, 527
in typhoid fever, 220
yellowish ulceration of frænum of, in pertussis, 208
Tongue-tie, 667
Tonic spasms in cerebro-spinal meningitis, 232
Tonics after parotitis, 200
after pericarditis, 948
in middle-ear inflammation, 1113
Tonsillitis, acute follicular, 434
infectious nature of, 434
treatment of, 436
croupous. See *Tonsillitis, infectious pseudo-membranous.*
infectious pseudo-membranous, 434
diagnosis of, 435
from diphtheria, 435
etiology of, 434
in rheumatism, 370
lacunaris, 434
parenchymatous, 437
phlegmonous, 437
simple follicular, 435
suppurative. See *Peritonsillar abscess.*
Tonsillotome, Mathieu's, 440
Tonsillotomy, author's method of, 441
Tonsils, hypertrophy of, 438
etiology and pathology of, 438
hyperplastic form of, 438
symptoms of, 439
treatment of, 439
Topophobia, 704
Torticollis with tumors of spinal cord, 803
Toxalbumin of diphtheria, 275
Trachea, relations of, in tracheotomy, 293
Tracheal dilators for tracheotomy, 295
forceps for tracheotomy, 295
Tracheitis, 896
Tracheo-bronchial glands, suppuration of, 109
tuberculosis of, 108
symptoms of, 109
Tracheotomy, 290

Tracheotomy, after-treatment of, 301
age in prognosis of, 294
anæsthetics in, 297
causes of death after, 304
choice of operations for, 296
complications after, 305
during operation of, 301
condition of patients after, 309
feeding after, 304
immediate results of, 301
indications for operation of, 293
in diphtheritic or membranous laryngitis, 292
instruments required for, 294
in treatment of foreign bodies in larynx and trachea, 867
in very advanced cases, 291
position of patient for, 297
prognosis of, 293
rapid, 309
removal of membrane in, 300
statistics of, 293
technique of, 298
thermo-cautery in, 309
time for operation of, 291
without tubes, 308
Tracheotomy-tube, care of, 303
change of, 303
difficulties in permanent removal of, 306
disinfection of, 303
permanent removal of, 303
Tracheotomy-tubes, 295
Trachoma. See *Conjunctivitis, granular.*
Trachoma-coccus, 1134
Traction upon prepuce in stone cases, 779
Tragus-pressure in chronic tympanic catarrh, 1119
Training in treatment of speech defects, 668
Transitory frenzy, 699
psychoses, 698
Transposition of arterial trunks, 944
Traumatic iritis, 1142
Traumatism in etiology of acute peritonitis, 579
of acute tubal nephritis, 983
of hysteria, 729
of pleurisy, 910
Treatment, general remarks on, 35
Tremor in hereditary ataxia, 818
in hysteria, 735
Trichiasis, 1126
Trichocephalus dispar, 553
Trichophyton fungus, 1096
Tricuspid regurgitant murmur, 955
Tricuspid regurgitation, 955
prognosis of, 956
valve, anomalies of, 942
Trigeminal pulsation, 960
Trommer's test for sugar, 973
Trophic disturbance in infantile cerebral palsies, 654
lesions in syringomyelia, 813
with tumors of spinal cord, 803
Tropical dysentery. See *Dysentery, amœbic.*
malaria. See *Æstivo-autumnal fevers.*
Trousseau mark in tubercular meningitis, 628
sign in tetany, 765
Trousseau's diuretic wine, 995
Trypsin in diphtheria, 286
Tubercle bacilli. See *Bacillus tuberculosis.*
in air, 98
in dust, 98
in milk, 110
diffuse infiltrated, 102
in etiology of typhlitis, 526
of conjunctiva, 1136
secondary inflammatory processes with, 103
Tubercular infection of newborn, 90
iritis, 1142
meningitis, 626
syphiloderm, 1088
tumors of brain and meninges, 637
Tuberculin, Hunter's modification of, 125
in lupus vulgaris, 1005
in tuberculosis, 125
Tuberculocidin in treatment of brain tumors, 645
Tuberculosis, 94
acute, Ehrlich's reaction in, 105
following operation, 101
miliary, 103
diagnosis of, 105
prognosis of, 105
pulmonary type of, 104
typhoid type of, 104
bacillus of, 95
chronic diffuse, 106
diagnosis of, 107
from gastro-intestinal catarrh, 107
from rickets, 107
from syphilis, 107
complicating broncho-pneumonia, 880
conditions favoring, 100
congenital, 97
experimental, 96
following acute gastro-intestinal catarrh, 106
following infectious disorders, 100
following measles, 106
Tuberculosis following whooping-cough, 106
general etiology and morbid anatomy of, 94
generalized forms of, 103
hæmoptysis in, 101
hereditary transmission of, theories of, 97
immunity in, 101
incidence of, statistics of, 95
in infancy and childhood, 94
in dairies, 99
in diabetics, 972
individual predisposition to, 100
in etiology of fibroid phthisis, 936
inoculation of, 98
local epidemics of, 98
localized, 107
modes of transmission of, 96
mortality of, 95
in prison, 98
of abdominal organs, 111
of Fallopian tubes, 123
of intestines, 111, 112
of kidneys, 122
of liver, 112
of lungs, 116
of lymph-glands, 107
of ovaries, 123
of pericardium, 122
of pleura, 122
of testis, 123
prophylaxis of, 123
pulmonary, 118
course of, 121
diagnosis of, 121
in etiology of bronchitis, 897
morbid anatomy of, 119
physical signs of, 120
prognosis of, 121
symptoms of, 119
relation of broncho-pneumonia to, 117
relation of scrofula to, 101
spontaneous cure of, 124
transmission of, by food, 99
by inhalation, 98
by meat, 99
by milk, 99
treatment of, 124
uro-genital, 122
Tuberculous diathesis, 100
characteristics of, 15
inflammation of middle ear, 1115
ulcer, description of, 111
virus in fœtus, 97
Tumor in hydatid of liver, 572
in hydronephrosis, 1002
in intussusception, 536
in suppurative hepatitis, 569
Tumors about crura cerebri, 643

Tumors at base of brain, 645
in causation of headache, 721
of brain and meninges, 636
comparative frequency of, 636
differential diagnosis of, 645
etiology of, 636
pathology of, 636
prognosis of, 645
symptoms of, 638
treatment of, 645
of cerebellum, 645
of conjunctiva, 1136
of cortical and subcortical regions, 640
of eyelids, 1124
of frontal lobe, 641
of kidney, 1006
diagnosis of, 1008
from ovarian cysts, 1008
from perityphlitic abscess, 1008
etiology and pathology of, 1006
prognosis of, 1008
symptoms of, 1007
treatment of, 1008
of medulla oblongata, 645
of motor area, 686
of occipital lobe, 642
of parietal lobe, 642
of pons, 644
of quadrigeminal region, 644
of spinal cord, 801
diagnosis of, 806
from fracture of vertebræ, 806
from hæmorrhage, 806
from hysteria, 806
from neuritis, 806
from pachymeningitis, 806
from spinal caries, 806
from transverse myelitis, 806
etiology of, 801
favorite sites of, 804
morbid anatomy of, 805
prognosis of, 807
surgical treatment of, 807
symptoms of, 801
type of, in cervical region, 805
in dorsal region, 805
in lumbar region and cauda, 805
of temporo-sphenoidal lobe, 643
of third frontal convolution, 642
Tuning-fork tests in young patients, 1120
Turpentine as a cause of hæmaturia, 904
in typhoid fever, 227
Tympanic attic, inflammation of, 1113
Tympanites in intussusception, 535
in peritonitis, 581
in typhoid fever, 220
Typhlitis, 525
Typho-bacillose, 105
Typhoid condition in purpura hæmorrhagica, 397
fever, 214
bacillus of, in drinking-water, 215
in milk, 215
clinical history of, 218
complicated by parotitis, 198
definition of, 214
diagnosis of, 223
from chronic gastro-intestinal catarrh, 224
from empyema, 224
from influenza, 224
from malarial fevers, 224
from meningitis, 224
from typhus fever, 224
difference of lesions of, in children and adults, 217
epidemics of, among children, 215
eruption in, 220
etiology of, 215
history of, 214
in etiology of bronchitis, 896
infectiousness of, 216
in infants, 215
mortality of, 224
pathology of, 217
prodromic symptoms of, 218
prognosis of, 224
prophylaxis of, 225
treatment of, 225
infection of new-born, 90
state in jaundice, 559
symptoms in rheumatism, 368
Typho-tuberculose, 105
Tyrotoxicon, 489

U.

Ulcer of cornea, 1138
treatment of, 1139
post-variolous, of lid, 1123
tuberculous, description of, 111
Ulceration of intestine in catarrhal dysentery, 502
of rectum, 605
of trachea after tracheotomy, 306
Ulcerous lesion of scrofuloderma, 1086
Ulcers, intestinal, in typhoid fever, 218
of amœbic dysentery, 506
phlyctenular, 1137
Ulna, changes in, in rachitis, 352
Umbilical cord. See *Cord, umbilical.*
hæmorrhage, 85
hernia, 86
polyp, 86
Umbilicus, warty tumor of, 591
Unguentum vaselini plumbicum, 1051
Uræmia in acute tubal nephritis, 983
Uræmic convulsions in acute tubal nephritis, 988
Urea in urine of chronic tubal nephritis, 991
Urethra, diagnosis of hæmorrhage from, 963
dilatation of, for stone, 1024
in females, 1018
in males, 1017
Uric acid as a cause of incontinence of urine, 970
in urine of new-born, 978
Uric-acid calculus, 1010
Uric-acid sediments in urine, 978
Urinary organs, anatomy of, in children, 1017
Urination, diminished frequency of, 9
involuntary, during sleep, 9
Urine. See, also, *Urine in health.*
examination of, in scarlet fever, 171
frequency of passage of, 8
in acute gastric catarrh, 459
in acute tubal nephritis, 983
in catarrhal dysentery, 504
in chlorosis, 379
in cholera, 260
in chronic tubal nephritis, 991
in cirrhosis of liver, 574
incontinence of. See *Incontinence of urine.*
in variola, 184
in vesical calculus, 1014
with seat-worms, 546
in diabetes mellitus, 972
in diphtheria, 278
in disease, 8
in erysipelas, 248
in health, 8
characteristics of, 9
daily amount of, 9
reaction of, 9
specific gravity of, 9
in jaundice, 559
in leukæmia, 390
in measles, 146
in perinephritic abscess, 1005

Urine in peritonitis, 581
in pyonephrosis, 1004
in rachitis, 343
in rheumatism, 368
in scarlatinal nephritis, 165
in simple atrophy, 522
in tumors of kidney, 1008
in whooping-cough, 207
partial suppression of, in chronic tubal nephritis, 992
in intussusception, 535
quantity of, in diabetes insipidus, 977
in diabetes mellitus, 972
selection of specimen of, for analysis for sugar, 973
specific gravity of, in acute tubal nephritis, 983
in diabetes insipidus, 977
in diabetes mellitus, 972
Urostealith, 1010
Urticaria, 1064
bullosa, 1064
diagnosis of, 1065
etiology of, 1064
factitia, 1064
hæmorrhagica, 1064
in simple atrophy, 521
papulosa, 1064
pigmentosa, 1065
prognosis of, 1065
treatment of, 1065
tuberosa, 1064
vesiculosa, 1064
with scarlet fever, 162
Uvula, abscission of, 433
elongation of, 433
Uvulatome, 433

V.

V-shaped indenture of jaw, 447
Vaccination, 191
after exposure to variola, 188
age at which to perform, 196
arm-to-arm, 195
by animal virus, 196
complications of, 194
constitutional symptoms of, 194
history of, 191
methods of, 195
points for, 196
protective power of, 196
exceptions to, 196
recent studies in, 193
secondary constitutional symptoms in, 194
secondary fever in, 194
Vaccine-blepharitis, 1123
Vaccine-lymph, animal, 193
superiority of, to humanized, 194
Vaccine-lymph from spontaneous cow-pox, 193
humanized, 193
transmission of syphilis by, 194
impurities of, 195
micro-organisms in, 193
selection of, 194
varieties of, 193
Vaccine-pock, areola of, 194
cicatrix of, 194
desiccation of, 194
injury to, 195
structure of, 193
Vaccine-syphilis. See *Syphilis after vaccination.*
Vaccinia, 191
auto-inoculation of, 194
coccus of, 193
eruptive, 194
etiology of, 191
irregularities in course of, 194
Jenner's theory of, 192
lymph of, characteristics of, 193
pathological anatomy of, 193
symptoms of, 194
theories of nature of, 192
theory of specific contagium of, 192
traditions of dairy-hands concerning, 191
variolation theory of, 192
vesicle of, 194
Vagi, compression of, by enlarged glands, 109
Vaginal lithotomy, 1024
Vaginismus in hysteria, 735
Valerian in diabetes insipidus, 978
Valsalva inflation in chronic tympanic catarrh, 1119
Valve-segments, numerical anomalies of, 944
Valvular disease of heart. See *Heart disease, chronic.*
drains in empyema, 920
Van Swieten's liquid, 140
in syphiloderma, 1090
Vapor-baths in ascites, 589
Varicella. See *Chicken-pox.*
gangrenosa, 181
with pertussis, 208
Varicella-prurigo, relation of, to eczema, 1064
Variola and varioloid, 183
complications and sequelæ of, 187
confluent, 186
course of, 185
definition of, 183
diagnosis of, 187
from measles, 187
from pneumonia, 187
from scarlatina, 187
from varicella, 187
discrete, 186
eruptive stage of, 184
Variola, etiology of, 183
hæmorrhagic, 186
incubation of, 184
after inoculation, 184
influence of vaccination in, 188
inoculation for, 191
invasion of, duration of, 184
Jenner's theory of, 192
mortality of, without vaccination, 196
pathological anatomy of, 183
prognosis of, 188
quarantine of, 190
second attacks of, 183
secondary fever in, 185
stage of invasion of, 184
striking distance of, 183
susceptibility to, 183
symptoms of, 184
transmission of, 183
treatment of, 188
typhoid symptoms in, 185
vaccination after exposure to, 188
varieties of, 186
Variola-lymph, 192
Variolation of cow, 192
Variola-vaccine, 193
Varioloid, definition of, 187
types of, 187
Vascular keratitis, 1140
Vaso-motor disturbance in syringomyelia, 813
involvement with tumors of spinal cord, 804
Vegetables in diabetic diet, 975
Vegetations in endocarditis, 949
post-tracheotomic, 308
Vein, meningeal, rupture of, 83
superficial anterior jugular, 292
Veins, jugular, fulness of, in rachitis, 355
Venous hum in chlorosis, 379
obstruction in etiology of ascites, 587
Ventricular septum, defect of, 941
Vernix caseosa, 1035
Verruca, 1074
diagnosis of, 1074
etiology of, 1074
necrogenica, 98
treatment of, 1075
Vertebræ, changes in, in rachitis, 348
Vertigo in acute tubal nephritis, 933
in brain tumors, 639
in leukæmia, 390
Vesical calculus, 1010
irritation in adherent prepuce, 1029
Vesicles of chicken-pox, 180
diagnosis of, from variola, 180

Vesicular syphiloderm, 1088
Villous growths in bladder a cause of hæmaturia, 964
Virchow's theory of congenital cystic degeneration of kidney, 999
of cretinism, 685
Visual fields, narrowing of, in hysteria, 733
Vocal resonance in pleural effusion, 914
Voice in cholera, 260
in simple catarrhal laryngitis, 846
Volatile antiseptics in diphtheria, 285
drugs in pertussis, 213
Volvulus due to ascarides, 544
Vomit, lumbricoid worms in, 9
Vomiting, 9
beef-juice in, 29
character of ejecta of, 9
chronic. See *Gastric catarrh, chronic.*
in acute gastric catarrh, 459
in acute milk infection, 492
in acute poliomyelitis, 791
in acute spinal leptomeningitis, 779
in broncho-pneumonia, 879
in cerebral meningitis, 615
in cerebro-spinal meningitis, 623
in childhood, 9
in cholera, 259
in chronic gastric catarrh, 464
in chronic intestinal indigestion, 485
in infancy, causes of, 9
in intussusception, 535
in malarial fever, 226, 330
in measles, 146
in migraine, 719
in onset of croupous pneumonia, 886
in peritonitis, 581
in pertussis, 208
in scarlet fever, 160
in simple atrophy, 521
in subacute milk infection, 496
in tubercular meningitis, 628
in typhlitis, 526
in typhoid fever, 220
in variola, 184
in whooping-cough, 207
uræmic, in acute tubal nephritis, 983
Vulvo-vaginitis, 1027
catarrhal, 1027
treatment of, 1028
from seat-worms, 546
gonorrhœal, 1027
diagnosis of, from catarrhal, 1027
treatment of, 1028
symptoms of, 1025
treatment of, 1028

W.

Wandering pneumonia, 888
Warner-Langenbeck method of staphylorraphy, 453
Warner's post-nasal douche, 836
Wart, post-mortem, 98
Warts of anus, 601
"Washerwoman's hands" in cholera, 260
Washing prohibited in eczema, 1049
Wasting in artificially-fed children, 519
in nursing infants, 520
Water as a source of typhoid fever, 216
in cholera, 268
in diet, 20
in lithiasis, 982
in scarlatinal nephritis, 171
in treatment of vesical calculus, 1017
lack of, in etiology of constipation, 513
Water-bed in acute myelitis, 787
Waxy kidney. See *Amyloid disease of kidney.*
Weaning, date of, 19
early, as a cause of rachitis, 360
gradual, 19
methods of, 19
premature, indications for, 20
sudden, indications for, 19
Weight, average, of new-born child, 12
daily increase in, 12
Werlhof's disease. See *Purpura hæmorrhagica.*
Wet-nurse, age of, 20
feeding by, 20
disadvantages of, 20
for syphilitic infant, 140
health of, 20
qualifications of, 20
rules for selection of, 20
Wharton's grooved director, 294
Whip-worm. See *Trichocephalus dispar.*
White liquefying germ, products obtained from, 489
Whooping-cough, 202
association of, with measles, 203
auscultation in, 207
catarrhal stage of, 205
complications and sequelæ of, 207
conditions of contagion in, 203
diagnosis of, 208
from bronchitis, 209
from broncho-pneumonia, 209
Whooping-cough, diagnosis of, from pulmonary tuberculosis, 209
from tuberculosis of bronchial glands, 209
during fœtal life, 203
etiology of, 202
followed by tuberculosis, 106
history of, 202
hygienic treatment of, 210
incubation of, 205
local treatment of, 212
mortality of, 209
paroxysmal stage of, 206
pathology of, 203
prognosis of, 209
prophylaxis of, 210
quarantine in, 210
second attacks of, 202
symptoms of, 205
mechanism of, 204
synonyms of, 202
terminal stage of, 207
theories of nature of, 204
treatment of, 210
Winckel's disease, 92
Wire loop for foreign body in auditory canal, 1109
Wooden resistance in pleural effusion, 914
Wormwood, oil of, in reflex vomiting of diphtheria, 284
Wounds of cornea, 1141
of eyelids, 1127
of rectum, 610
Wright's adaptation of Mackenzie tonsillotome, 441

X.

Xanthic-oxide calculus, 1010
Xeroderma pigmentosum, 1081. See *Kaposi's disease.*
Xerophthalmos, 1140
Xerosis of conjunctiva, 1134, 1140

Y.

Yawning, significance of, 10
Yellow-oxide-of-mercury ointment in eczema of lids, 1054

Z.

Zinc-and-tar salve, 1051
Zinc oxide in jaundice, 564
Zona. See *Herpes zoster.*
capillitii, 1060
facialis, 1060
frontalis, 1060
nuchæ, 1060
ophthalmicus, 1060
Zonular cataract. See *Cataract, congenital.*

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INDEX.

*American Text-Books, 1–4.
Anatomy, Nancrede, 20.
and Manual of Dissection, Nancrede, 15.
Morbid, Semple, 21.
Asepsis, Surgical, Beck, 9.
*Autobiography of Gross, 7.
Bacteriological Laboratory, Frothingham, 12.
Bacteriology, Ball, 25.
Bandaging (see Minor Surgery).
Botany, Bastin, 17.
Chemistry, Wolff, 21.
*Children, Diseases of (see Diseases).
Compends, Question, Saunders', 19.
Diagnosis, Medical, Cohen and Eshner, 24.
* Vierordt and Stuart, 6.
*Dictionary, Medical, Keating, 17.
(Pocket), Saunders, 17.
Nurses', Morten, 26.
Diseases, Nervous, Burr, 10.
and Insanity, Shaw, 25.
* of Children, American Text-Book, 3.
Essentials, Powell, 24.
of Nose and Throat, Kyle, 10.
of the Ear, Gleason, 26.
* of the Eye, De Schweinitz, 5.
of the Eye, Nose, and Throat, Jackson and Gleason, 23.
of the Skin, Stelwagon, 22.
of Women, Garrigues, 14.
Syphilis and Venereal, Hyde, 10.
Venereal, Martin (see Minor Surgery).
Dissection, Manual of, Nancrede, 15.
Dose-Book and Prescription-Writing, Thornton, 12.
Ear, Diseases of, Gleason, 26.
Electricity, Medical, Stewart and Lawrance, 26.
*Eye, Diseases of, De Schweinitz, 5.
Essentials of, Jackson and Gleason, 23.
Formulary, Medical, Saunders', 18.
*Gynecology, American Text-Book of, 4.
Essentials of, Cragin, 22.
Syllabus, Long (*cover* p. 3).
Hygiene, Semple, 23.
Insanity (see Nervous Diseases).
Jurisprudence and Hygiene, Semple, 23.
and Toxicology, Chapman, 11.
Laboratory Exercises in Botany, Bastin, 17.
Guide to Bacteriological, Frothingham, 12.
Lectures, Obstetrical, Syllabus of, Norris, 16.
on Surgery, Syllabus of, Senn, 15.
Legal Medicine, Toxicology, and Hygiene, Semple, 23.
Lexicon, Medical (Pocket), Saunders', 17.
Life Insurance, How to Examine for, Keating, 18.
Manuals, New Aid Series, Saunders', 9, 10.
Materia Medica and Therapeutics, Griffin, 10.
and Therapeutics, Morris, 21.
and Therapeutics, Stevens, 18.
Medical Diagnosis, Cohen and Eshner, 24.
* Diagnosis, Vierordt and Stuart, 6.
Dictionary, Keating, 7.
Electricity, Stewart and Lawrance, 26.
Formulary (Pocket), 18.
Medical Jurisprudence and Toxicology, Chapman, 12.
Lexicon, Saunders', 17.
Medicine, Legal, Semple, 23.
* Practice of, American Text-Book, 2.
Manual, Lockwood, 10.
Manual, Morris, 22.
Manual, Stevens, 15.
Minor Surgery, Bandaging, and Venereal Diseases, Martin, 23.
Nervous Diseases, Burr, 10.
Diseases and Insanity, Shaw, 25.
Newer Remedies, Notes on, Cerna, 16.
Nose, Diseases of, Jackson and Gleason, 23.
and Throat, Diseases of, Kyle, 10.
Nurses' Dictionary, Morten, 26.
*Nursing, American Text-Book (*cover* p. 4).
Hampton, 13.
*Obstetrics, American Text-Book of (*cover* p. 4).
Essentials, Ashton, 21.
Manual, Dorland, 12.
Outlines of, Jewett, 16.
Syllabus of, Norris, 16.
Operation Blanks, Keen, 13.
Orthopædic Surgery, Wilson, 13.
Pathology and Morbid Anatomy, Semple, 21.
Surgical, Warren, 8.
Pharmacy, Practice of, Sayre, 24.
Physics, Brockway, 25.
*Physiology, American Text-Book of (*cover* p. 4.)
Essentials, Hare, 20.
Manual, Raymond, 12.
*Practice of Medicine, American Text-Book, 2.
Essentials, Morris, 22.
Manual, Lockwood, 10.
Manual, Stevens, 15.
of Pharmacy, Sayre, 24.
of Surgery, American Text-Book of, 1.
Prescription-Writing (see Dose-Book).
Remedies, Notes on the Newer, Cerna, 16.
Skin, Diseases of, Stelwagon, 22.
*Surgery, American Text-Book of, 1.
Essentials, Martin, 20.
Manual of, DaCosta, 11.
Minor, Martin, 23.
Orthopædic, Wilson, 13.
Syllabus of Lectures on, Senn, 15.
Syllabus of Gynecology, Long (*cover* p. 3).
of Lectures on Surgery, Senn, 15.
of Obstetrical Lectures, Norris, 16.
Syphilis and Venereal Diseases, Hyde, 10.
Temperature Charts, Lainè (*cover* p. 3).
*Therapeutics, American Text-Book (*cover* p. 4).
Essentials, Morris, 21.
Manual, Stevens, 18.
Medical, Griffin, 10.
Surgical, Warren, 8.
Throat, Diseases of, Jackson and Gleason, 23.
Manual, Kyle, 10.
Toxicology, Semple, 23.
Medical Jurisprudence and, Chapman, 12.
Urine, Examination of, Wolff, 24.
Venereal Diseases, Hyde, 10 (see Diseases).
Women, Diseases of, Garrigues, 14.

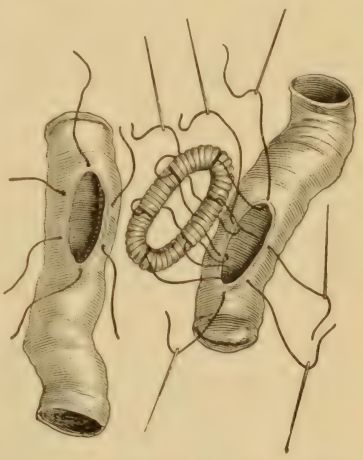
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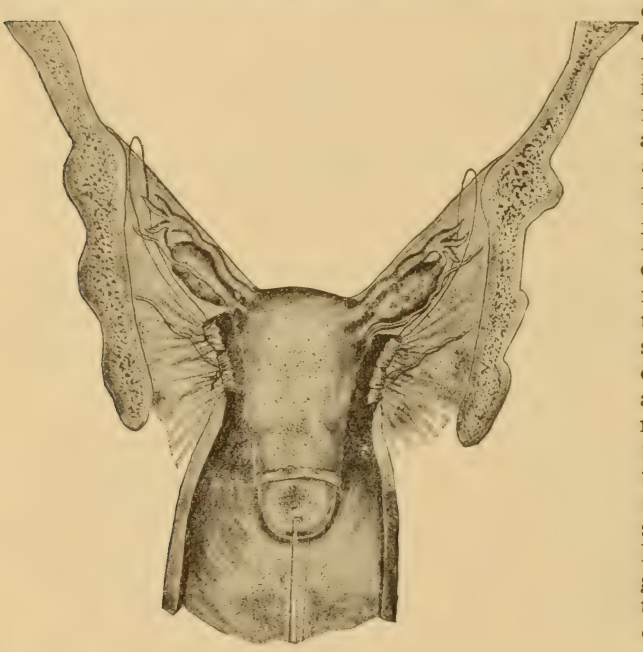
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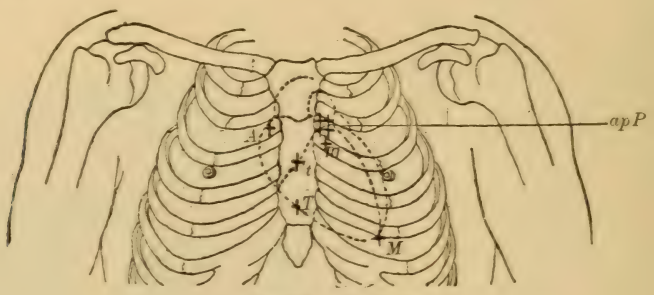
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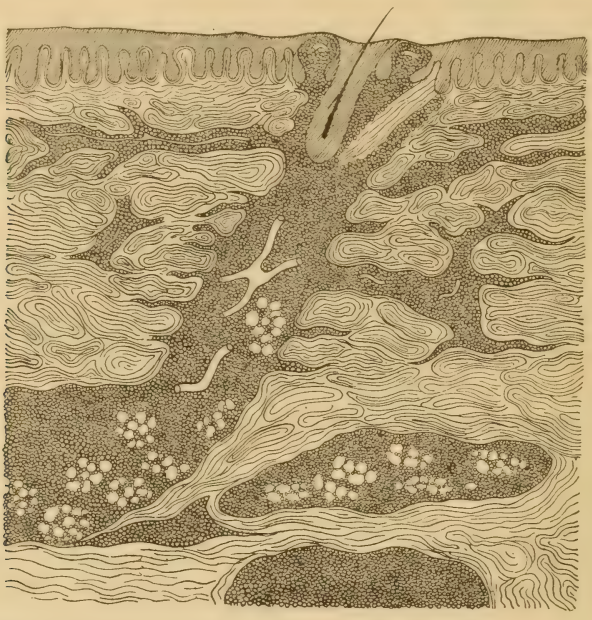
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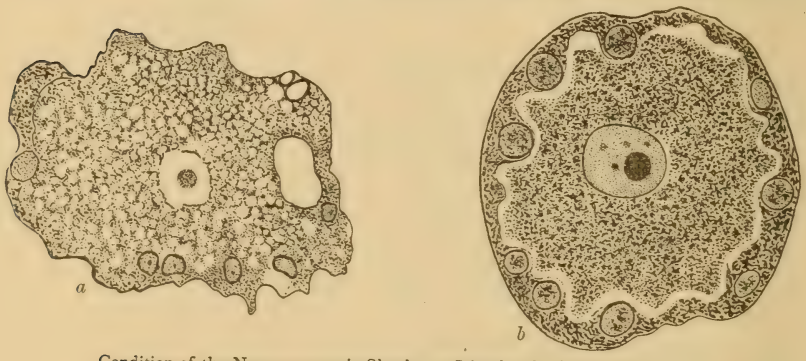
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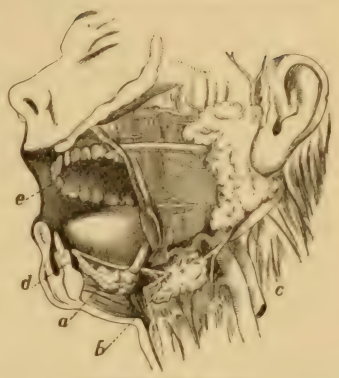
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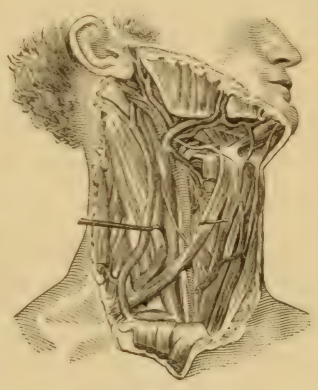
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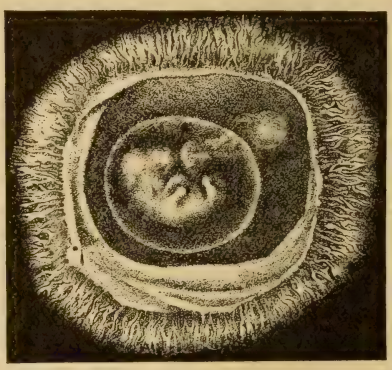
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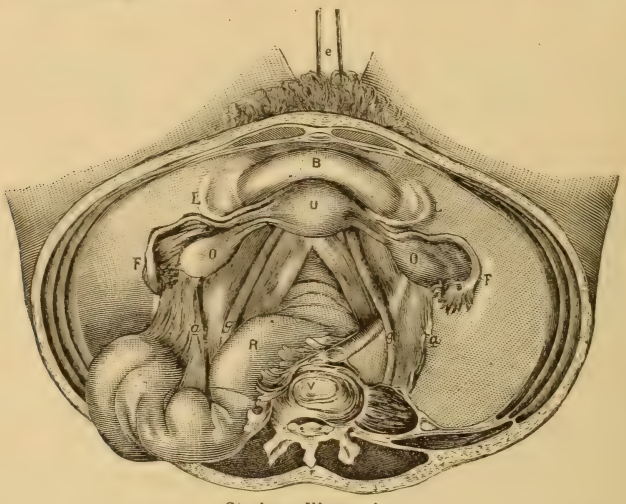
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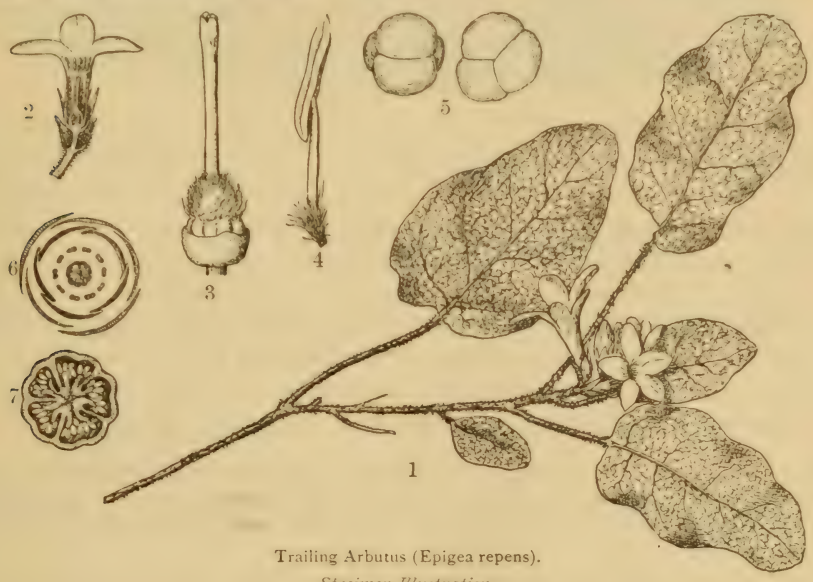
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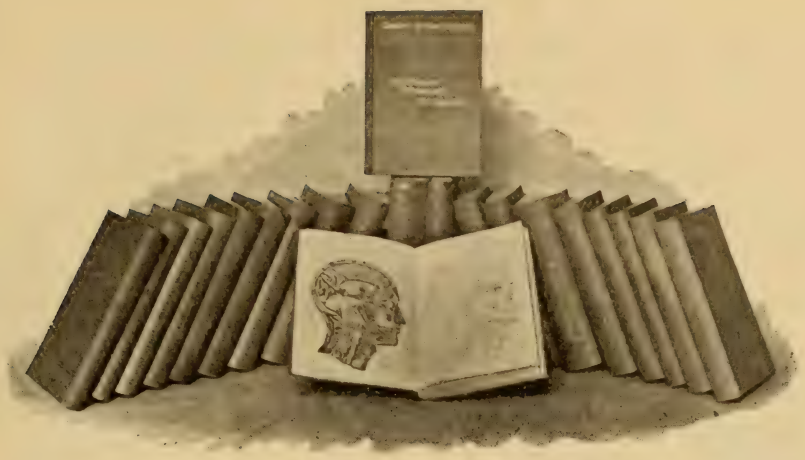
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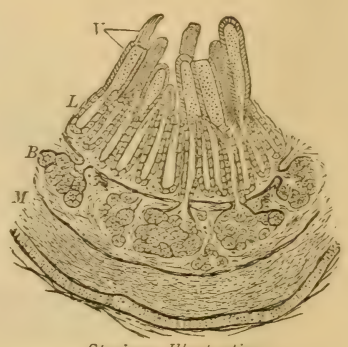
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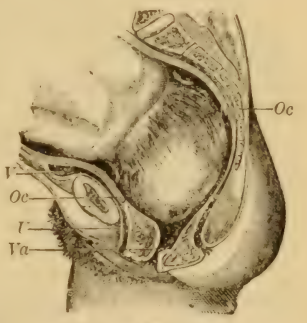
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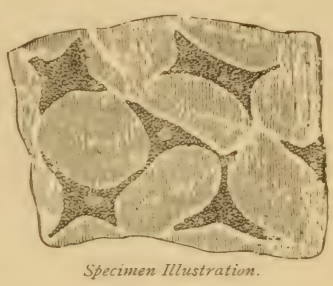


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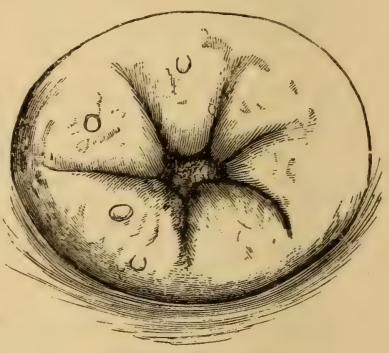
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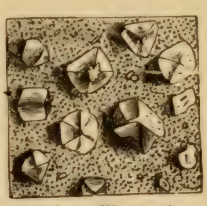


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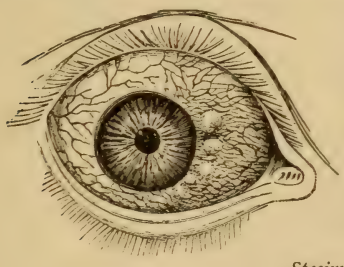
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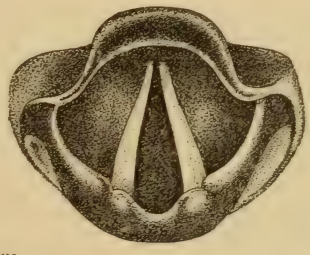


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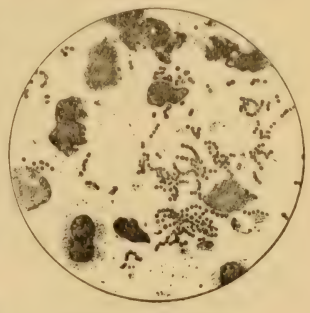
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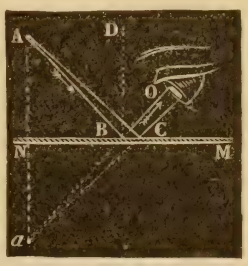
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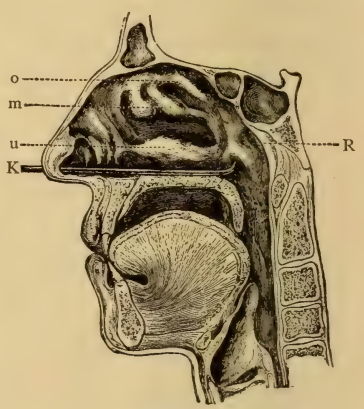
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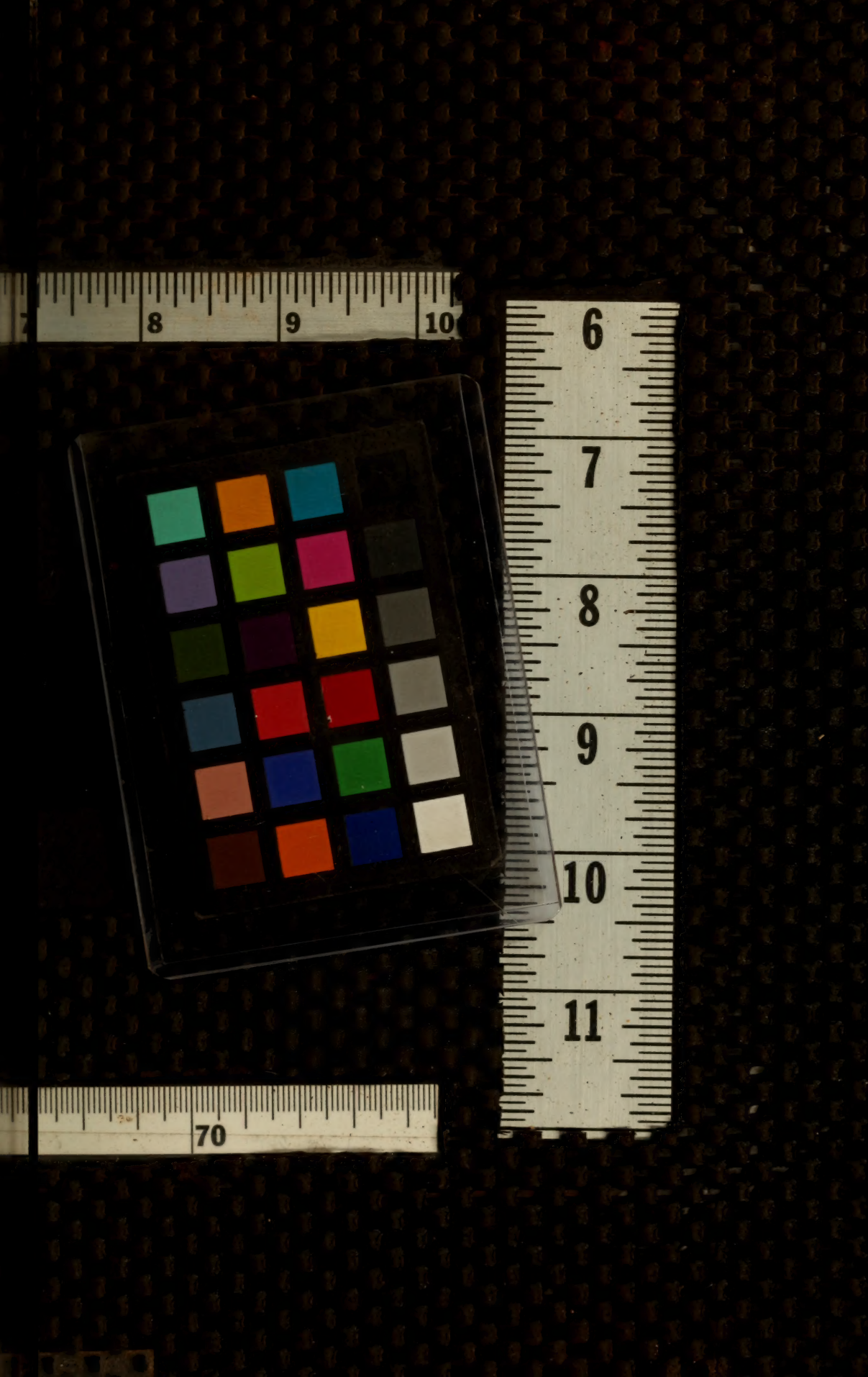
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